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# HIGHWAY COMMISSION REPORT
# ILLINOIS, 1907

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# Second Annual Report

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OF THE

# ILLINOIS HIGHWAY COMMISSION

FOR THE YEAR 1907.

SPRINGFIELD, ILL.:
PHILLIPS BROS., STATE PRINTERS
1908.

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SAN DIEGO
MARINE

# ILLINOIS HIGHWAY COMMISSION.

---

EDMUND J. JAMES, *Chairman,* Urbana.

JOSEPH R. FULKERSON, Jerseyville.

LAFAYETTE FUNK, Shirley.

---

A. N. JOHNSON, *State Engineer.*

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# LETTER OF TRANSMITTAL.

SPRINGFIELD, ILL., March 1, 1908.

*To the Honorable Board of State Highway Commissioners, Springfield, Ill.:*

GENTLEMEN—I beg to submit herewith my report as engineer to the commission for the year 1907. Very respectfully,

A. N. JOHNSON,
*State Engineer.*

Road Commissioners, Supervisors and Business Men's Club of Kewanee, Neponset and Wethersfield, starting on tour of inspection of dragged earth roads maintained by Galva Good Roads Association, Galva, Henry county.

# INTRODUCTION.

In reviewing the work of the State Highway Commission for 1907 and the results accomplished, the attention is first held by the greatly increased interest in the subject of road improvement that is shown in nearly every section of the State. Evidence of the fact is best shown by the large number of public meetings to which the Highway Commission has been requested to send a speaker to discuss some topic connected with road improvement. One hundred and eleven meetings were attended during the year 1907. These meetings were held under the auspices of various organizations. Ninety-eight were farmers' institutes, others being business men's associations and citizens' meetings, which indicates how general and widespread is the attention given to this public question.

The increasing number of inquiries and requests for information and bulletins and the work accomplished by local road organizations are added evidence.

## Should First Obtain Better Results From Present Road Taxes.

The Highway Commission, in all its work and discussions before the farmers' institutes and other meetings, has tried to make it clear that road improvement does not necessarily mean the construction of gravel or macadam roads; that the construction of gravel or macadam roads for the present is not to be advised, except under certain conditions. At first immediate attention should be given to those methods by which better results can be obtained with the money that is already available for road and bridge maintenance. Such a program has appealed to the common sense of the average tax payer, as is evidenced by support given the work of the Highway Commission at the farmers' institutes.

The commission, however, has not been unmindful of the fact that to confine its work entirely to the discussion as outlined above does not give proper consideration to the present and future needs of the progressive communities in the State; and it is convinced that it is full time that plans should be discussed which may result in the construction of such roads as are unquestionably a present need.

## Concrete Bridge Construction.

It is believed that attention should first be directed towards some comprehensive plan of bridge construction, so far at least as smaller span bridges are concerned. That this should be given first consid-

eration is apparent when we consider that no matter what the character of the road, it is necessary to have bridges that will sustain the loads that come upon them, and the bridge on the sparsely traveled road may have quite as heavy a load come upon it as the bridge upon the much more traveled road, so that the bridge requirements are more nearly the same for all localities than is the case with the character of the road surface.

Particular mention is made of the small span bridges, because they constitute by far the largest proportion of the bridges and at present require much the greater amount of money for their maintenance. As is pointed out in the chapter upon bridges, practically all of the bridge money spent today is really for bridge maintenance rather than for the construction of new bridges, including under maintenance renewals of bridges which have become useless.

If, therefore, some plan could be devised by which this present constant maintenance expense could be avoided, it should receive earnest and immediate attention.

After a careful study and actual experience with conditions in all parts of the State, it is recommended that all bridges of fifty foot span or less should be constructed of concrete or reinforced concrete, as this is the most permanent form of construction known to engineers today.

The plan proposed is for a township to have a careful inspection made of all bridges and the required sizes noted and listed. There would be found, for instance, to be a certain number of three foot openings, a certain number of ten foot openings and so on. Plans for the various sized bridges could then be made and the total amount of work necessary and the estimated cost ascertained. The township would then undertake to build all of these bridges within one or two years, securing the necessary funds by issuing bonds for the required amounts. The work could be let in one contract of sufficient magnitude to secure keen competition, and from the fact that many bridges would be duplicated, a contractor could undertake the work at a much lower figure than would be possible if the bridges were contracted at different times.

The result would be the canceling of the greater portion of the bridge tax that the townships are now called upon to pay and the money now apportioned for bridge maintenance would in most cases be ample to pay the interest and sinking funds on the bonds. From the fact that the structures that would be built are of such a permanent character, it is in every way just that the cost should be distributed over a number of years and would entirely justify bonds running for at least twenty-five years. Such a plan, however, should not be undertaken without certain limitations, to insure, first, the proper design of these bridges and, second, their proper construction. Such additional legislation as might be necessary to make this plan effective should require that all plans for this work should be approved by the State and the work carried on under State specifications. This would be necessary to safeguard and secure to the tax payers the standard of design and construction that work of this character requires and public safety demands.

## Abuse of County Aid for Bridges.

While there may be many features of the present road and bridge law which might be modified to advantage, there is an abuse which has crept in under the provisions giving county aid for bridges costing over a certain portion of the available taxation in a township, that demands earnest consideration.

The intent of the law is manifest and when executed in the right spirit it is equitable and just, inasmuch as it provides for assistance to townships in constructing the larger and more expensive bridges which are frequently of service to others than the residents of the township in which the bridge is located. There has, however, grown up a practice in many instances where the cost of the bridge is close to the limit for which county aid may be secured, for the township officials to desire a bridge at somewhat extra cost in order that county aid may be secured, so that only half the expense will be borne by the township. For example, cases somewhat as follows have arisen in connection with the work done by the State Highway Commission: Bids for a bridge, which was estimated to cost about $800 and for which proposals were received for this amount, were rejected by the township officials and another letting secured on other plans substituting a bridge costing something over $1,000. In this case, for a bridge costing over $1,000, it was possible to secure county aid, which was done. The rejected bridge was as adequate a structure as the higher priced one, but, in order that the township might save $200 or $300 the tax payers of the county at large were obliged to pay $200 or $300 more than they should.

In other cases township officials have complained of the estimated cost because it was too low for them to secure county aid. They wanted the price of the bridge increased, and sometimes they were entirely willing for bids to be higher on the same structure in order to secure county aid and lessen the cost to themselves.

The result is added expense to the tax payers of the county as a whole and increased profit to the bridge contractors who, in many cases, know the price at which a bridge should be built in order to secure county aid, and make their bids accordingly, thereby getting increased profits for themselves, usually with the full knowledge and consent of the township officials.

At least a partial remedy would be to change the law governing county aid so that it would be impossible that the amount a township would pay should be reduced by receiving county aid. This would mean an adjustment of the county's contribution from a very small amount up to a full half of the cost.

For example, instead of granting, as at present, county aid for half the amount when a bridge costs over 20 cents on the $100 of the assessed valuation of a township, to grant it when a bridge is to cost, let us say, 15 cents on the $100, under the following plan: That all over this amount will be paid by the county up to a full half of the cost, but in no event is the county to pay more than half the cost.

To illustrate how this would work practically, let us suppose that 15 cents on the $100 in a given township nets $1,000. Thus, if a bridge should cost $1,200, the township would pay $1,000 and the county $200. If a bridge were to cost $2,000, the county would pay $1,000 and the township $1,000. If a bridge were to cost $3,000, the county would pay $1,500 and the township $1,500, and so on.

This subject is brought up for the purpose of emphasizing the condition that exists, in order that due consideration may be given to provide effective means to annul the present abuse.

## Road Construction About Cities and Towns.

Aside from the proper maintenance of the thousands of miles of earth roads of the State, there is today a need and demand for a system of roads leading from the larger cities and shipping points, which shall be so constructed as to meet the requirements of the large amount of traffic that is found on such roads.

The sections of roads which carry a large number of vehicles (which is evidence that the community uses such roads to a far greater extent than others) cannot be kept in satisfactory condition as earth roads, and it is necessary, if a suitable road surface is to be maintained, to provide some more durable form of construction, such as gravel or macadam.

That such a system of roads in any particular locality would materially aid the development of that section is no theory, but an established fact, from the experience of communities situated all over the country. Therefore, our attention is first directed to the necessity for some provision by which the different communities throughout the State who so desire will be enabled to undertake the development of the roads in their vicinity. At present arbitrary political boundaries prevent coöperation between people in the cities and in the outlying districts. In the matter of road development, however, their interests are mutual, and there should be some way provided by which one may assist the other to accomplish mutual good. Possibly some arrangement could be made by which certain districts could be formed at the option of the people themselves in a way somewhat similar to the drainage districts.

## Through Roads Not Required.

There is a plan about which much is heard, but which does not seem to meet the economic needs of this State, and that is the construction of through roads. Whatever may be the future development of road traffic in this State, such roads are not today required. If any evidence were necessary, the traffic census taken by the State Highway Commission, which shows that the majority of the travel of today is on the first few miles from a given center, demonstrates that through travel practically does not exist. What is first needed is the development of roads around the various centers, and when this has been accomplished it will be full time to take up the question of through roads, if then required.

In connection with the above discussion, it will be interesting to note the report of the committee of highways of the Illinois Farmers' Institutes, presented at the meeting of the board of directors on February 25, 1908, which is given here in full:

## REPORT OF THE COMMITTEE ON HIGHWAYS OF THE ILLINOIS FARMERS' INSTITUTE.

Your committee begs leave to submit the following report of its work and findings for the past year.

We have been chiefly concerned in coöperating with the Illinois Highway Commission and in noting the progress of its work. As a result of this coöperative work, your committee believes that a greater interest in the subject of improved earth roads and bridges has been aroused than ever before in the history of the State. As an evidence of this, attention is called to the fact that a few years ago so little interest and effective coöperation could be secured that the majority of directors of institutes would not put a road subject on the programs. A year ago, 67 requests were sent to the State Highway Commission for speakers. As the work of the commission was hardly organized, it was found impossible to get speakers to send to more than 41 of these institutes. This past year, requests were received from all but two of the counties and the Highway Commission has furnished speakers for 105 institutes. A number of the counties where more than one institute was held asked for the road topic in each instance.

The influence of this committee has been exerted to impress the importance of better methods of maintenance of our earth roads, which work has been most thoroughly undertaken by the Highway Commission. Perhaps the most important step in this matter was the passage by the Legislature of what is known as the road drag law. A draft of this law was submitted to your committee who gave the subject careful consideration, and, after conferring on the matter with the State Highway Commission, a bill was introduced into the Legislature and became a law in accordance with the recommendations submitted, with the exception that the clause providing that the dragging should be done in accordance with the instructions of the State Highway Commission was omitted, and in place thereof there was substituted the clause that the dragging should be done in accordance with the instructions of the township commissioners. This change your committee believes to have been an unwise one, although it may not result in very much practical difference.

The State Highway Commission has issued a bulletin giving the full text of the law and explicit directions concerning the use of the drag, so that there can be no opportunity for doing this work in any other than the proper way. There have been distributed 75,000 copies of the bulletin concerning the road drag and at present a fourth edition of 25,000 is being distributed.

Much interest has been aroused in the subject of improved bridges, and this your committee believes to be of great importance and is pleased to note the progress in this branch of the work which has been carried on by the State Highway Commission, particularly in the use of reinforced concrete construction for all small bridges.

No matter what the kind of road, bridges are necessary. It is the opinion of your committee that this subject, which is of importance to every township, should receive first attention to the end that as soon as possible all of the small span bridges, that is, up to 40 or 50 feet, should be replaced as rapidly as possible with reinforced concrete structures. The result of this policy would be that in a very short time townships would do away entirely with a large part of their present bridge tax and would have this money available for other purposes.

Your committee would call attention to the important investigations that the Highway Commission is making on the subject of reinforced concrete bridges. There has been constructed, in coöperation with the authorities of the Southern Illinois Penitentiary, a full sized reinforced concrete bridge.

This bridge has a span of 40 feet and a clear roadway of 18 feet. It was built by convict labor, so that the cost to the State has been but a few dollars for the necessary amount of reinforcing rods, cement and sand. The Highway Commission proposes to carry on a series of tests on this bridge which will bring out many points of scientific value.

In addition to this phase of the value of the test, your committee believes that there will be another feature which is quite as important and valuable, namely, the great amount of public interest such a test will arouse. When it is realized the loads that bridges of this construction can bear, increased confidence in this form of construction will be inspired in the public mind.

Your committee is informed that this is the largest test of this kind ever undertaken in this country, and is one that will attract the attention not only of engineers, but of all who are interested in rural bridge construction. Your committee is in receipt of an invitation from the State Highway Commission to be present at some of these tests and will submit a further report on this matter.

There is one feature of the road improvement agitation of which much is heard at present and one which your committee believes should not pass without comment, that is the construction of through roads. Such roads we believe are not at present required by the people throughout the State generally, and that in the absence of radial roads extending for a few miles in different directions from the various centers towards which travel goes, consideration of any plans for through roads is at present premature and is wasting, uselessly, energy which it would be far better to apply towards agreeing on various points and submitting plans to secure well constructed radial roads.

There is no question but that in the vicinity of the larger towns and cities where travel is concentrated on the roads immediately adjacent, the ordinary earth roads do not suffice for such heavy traffic, and that under these conditions it is necessary to make a more durable form of construction either of gravel or macadam. Moreover, on all roads where there is a large amount of traffic, money spent in durable road improvement is a good investment for that community. The fact, however, that the people in the towns are equally interested in having trade attracted into town and therefore have a substantial reason for wanting the roads roundabout improved, it would seem that the proper plan for having such road improvement would be such as would make it possible for coöperation of the people in the cities with the people in the country, each to bear a certain share of the expense.

We would call special attention to the Randolph county road commissioners' organization, which is an association of the highway commissioners of that county, which meets once or twice a year for the purpose of discussing road work.

At these meetings they have secured speakers from the State Highway Commission and elsewhere. The meetings have been well attended and of interest and value to all who participated.

We believe that such associations should be formed in every county in the State and include all officials who have to do with either road or bridge construction.

If it is necessary for the organization of such associations we would recommend the passage of such legislation as would effect this purpose and would recommend that officials attending these meetings or road institutes should be allowed their per diem charge together with their traveling expenses. Whatever money the tax payer was called upon to spend in this way could not be put to a more profitable use.

Your committee has made itself thoroughly conversant with all the phases of the work of the Illinois Highway Commission and bespeaks for it the hearty support and coöperation of citizens in all parts of the State.

# Farmers' Institutes and Road Meetings.

## Resolutions Passed by State Farmers' Institute.

Coöperation with the work of the Farmers' Institute has been undertaken in every way possible, and has proven one of the most effective means to make known generally the way the work of the Highway Commission is of practical value to the people of the State. The following resolutions were passed at the State Farmers' Institute at Quincy, in February, 1908:

Whereas, The State Highway Commission is doing educational work of wide value, and carrying on experiments in various kinds of road construction of service to all communities; and,

Whereas, Its assistance and the results of its work have proven that it does save money to the taxpayers by securing improved roads and bridges; therefore, be it

*Resolved*, That the State Farmers' Institute in convention assembled again heartily commends the methods and work of the State Highway Commission and urges increased coöperation with it on the part of all local road and bridge officials.

During the season of 1906-1907 sixty-seven requests were received from farmers' institutes to furnish speakers to discuss a road topic. As was stated in the report of 1906, owing to the fact that the Highway Commission had at that time just organized, it was impossible to furnish speakers for all. Speakers were sent, however, to forty-one of the institutes.

For the season of 1907-1908, requests were received from 105 institutes, and speakers furnished in every instance.

The great number of requests received, and the fact that they came from practically every county in the State, shows how widespread this interest has become. It is particularly significant from the fact, as mentioned in the report of the highway committee of the Farmers' Institute (which is given in full in the introduction of this report), that four or five years ago there was so little interest in this subject, combined with the antagonistic views held by many, that there was scarcely a director of an institute who would consider having a road topic upon the program.

The results of the institute work that was done a year ago are clearly seen in the practical work carried on by the commission this past year, as the majority of the requests for the advice and assistance of the commission came from those counties where speakers had attended institutes.

In addition to the institutes, a number of other meetings have been attended which were held under various auspices. A number of State associations, such as the Corn Growers' and Stockmen's, Illinois Press Association, Illinois Manufacturers' Association, State Association of County Clerks and Supervisors, requested that a speaker be furnished by the State Highway Commission for their annual convention program. Requests were also received from a number of business men's associations in different places in the State.

The number of meetings, including farmers' institutes that were actually attended during the calendar year of 1907, was 111 as compared with 48 attended in 1906. Of the 111 meetings attended, 98 were Farmers' Institutes, 7 were State associations, leaving 6 divided among business men's associations and others. A complete list of these meetings is given in the adjoining table:

## Table I.

### *Meetings Attended.*

| Date. | | County. | Town. | Association. |
|---|---|---|---|---|
| 1907 | | | | |
| January | 10 | Edgar | Paris | Farmers' Institute |
| | 10 | LaSalle | LaSalle | ..do |
| | 10 | Piatt | Bement | ..do |
| | 11 | Douglas | Arcola | ..do |
| | 11 | Vermilion | Hoopeston | ..do |
| | 12 | Coles | Charleston | ..do |
| | 15 | DeKalb | Waterman | ..do |
| | 16 | Winnebago | Rockford | .do |
| | 17 | Kane | Geneva | ..do |
| | 17 | ..do | Aurora | Federation Woman's Club |
| | 18 | Iroquois | Gilman | Farmers' Institute |
| | 19 | Kankakee | Kankakee | ..do |
| | 23 | Henry | Galva | ..do |
| | 24 | Peoria | Peoria | Illinois Society Engineers and Surveyors |
| | 26 | Champaign | Urbana | Corn Growers' and Stockmen's Convention |
| February | 2 | St. Clair | O'Fallon | Citizen's meeting |
| | 6 | Sangamon | Springfield | Business Men's Association |
| | 7 | Ogle | Polo | Citizen's meeting |
| | 20 | Adams | Quincy | State Convention of Illinois Farmers' Institute |
| | 21 | ..do | ..do | ..do |
| March | 9 | Sangamon | Auburn | Farmers' Club |
| | 12 | Pittsburg | Pennsylvania | American Road Makers' Ass'n |
| | 30 | Massac | Metropolis | Citizen's meeting |
| April | 23 | Washington | Nashville | Board of Supervisors |
| June | 6 | Peoria | Peoria | Illinois Press Association |
| | 10 | Madison | Edwardsville | County Supervisors |
| | 13 | LaSalle | Ottawa | ..do |
| | 13 | ..do | LaSalle | LaSalle Merchant's Association |
| August | 16 | Randolph | Sparta | Citizen's meeting |
| | 21 | Jackson | Carbondale | Farmers' Institute |
| | 22 | Williamson | Cartersville | ..do |
| | 23 | Franklin | Benton | ..do |
| | 29 | Iroquois | Cisna Park | Old Settlers' Reunion |
| September | 4 | Council Bluffs. | Iowa | State Road Convention of Iowan Road Supervis'rs |
| | 12 | Milwaukee | Wisconsin | State Road Convention |
| | 19 | Champaign | Champaign | Chamber of Commerce Citizen's Meeting |
| | 26 | Peoria | Trivoli | Farmers' Institute |
| | 27 | Tazewell | Morton | ..do |
| October | 8 | Schuyler | Rushville | ..do |
| | 8 | Warren | Alexis | ..do |
| | 9 | Cass | Virginia | ..do |
| | 9 | Cook | Chicago | Illinois Manufacturers' Ass'n |
| | 9 | Knox | Abingdon | Farmers' Institute |
| | 10 | Cook | Chicago | State Convention of County Clerks and Superv's. |
| | 10 | Mason | Mason City | Farmers' Institute |
| | 10 | McDonough | Bushnell | ..do |
| | 15 | Cook | Chicago | National Corn Exposition |
| | 16 | Christian | Taylorville | Farmers' Institute |

*Table I*—Concluded.

| Date. | | County. | Town. | Association. |
|---|---|---|---|---|
| October | 21 | Wayne | Cisne | Farmers' Institute |
| | 22 | White | Norris City | do |
| | 22 | Morgan | Chapin | do |
| | 23 | Hamilton | McLeansboro | do |
| | 23 | Shelby | Windsor | do |
| | 23 | Union | Jonesboro | do |
| | 23 | Pike | Griggsville | do |
| | 24 | Clay | Xenia | do |
| | 24 | Pulaski | Villa Ridge | do |
| | 24 | Brown | Mt. Sterling | do |
| | 25 | Edwards | Albion | do |
| | 25 | Cumberland | Toledo | do |
| | 25 | Alexander | Thebes | do |
| | 25 | Madison | Highland | do |
| | 26 | Monroe | Waterloo | do |
| | 26 | Wayne | Wayne City | do |
| | 30 | Clinton | Breese | do |
| | 30 | Pope | Golconda | do |
| | 30 | Marion | Karbers Ridge | do |
| | 31 | Marion | Salem | do |
| | 31 | Gallatin | Ridgeway | do |
| November | 1 | Montgomery | Litchfield | do |
| | 2 | Massac | Metropolis | do |
| | 8 | Sangamon | Springfield | do |
| | 9 | Macoupin | Bunker Hill | do |
| | 13 | Wabash | Mt. Carmel | do |
| | 14 | Jefferson | Mt. Vernon | do |
| | 14 | St. Clair | Mascouta | Citizens' Protective Association |
| | 14 | Fulton | Arlington | Farmers' Institute |
| | 14 | St. Clair | Belleville | do |
| | 15 | Richland | Olney | do |
| | 15 | Adams | Camp Point | do |
| | 15 | Washington | Okawville | do |
| | 16 | Effingham | Effingham | do |
| | 20 | Randolph | Red Bud | do |
| | 21 | Randolph | Coulterville | do |
| | 23 | Perry | Pinckneyville | do |
| December | 3 | Mercer | Aledo | do |
| | 5 | Hancock | Carthage | do |
| | 10 | Whiteside | Sterling | do |
| | 10 | Stark | Lafayette | do |
| | 10 | DeKalb | DeKalb | do |
| | 10 | Jersey | Jerseyville | do |
| | 10 | Fayette | Vandalia | do |
| | 11 | Lee | Franklin Gr've | do |
| | 11 | Marshall | Toluca | do |
| | 11 | Green | Whitehall | do |
| | 11 | Jasper | Newton | do |
| | 12 | Bureau | Arlington | do |
| | 12 | McLean | Bloomington | do |
| | 12 | Ogle | Mt. Morris | do |
| | 12 | Crawford | Robinson | do |
| | 13 | Logan | Lincoln | do |
| | 13 | Putnam | Putnam | do |
| | 13 | Woodford | Metamora | do |
| | 14 | Calhoun | Kampsville | do |
| | 17 | Woodford | El Paso | do |
| | 18 | Macon | Decatur | do |
| | 18 | Woodford | Roanoke | do |
| | 19 | Coles | Charleston | do |
| | 19 | Ford | Gibson City | do |
| | 19 | Woodford | Eureka | do |
| | 20 | Cook | Chicago | Cement Products Exposition |

## Road Improvement Association.

In the chapter under this same heading in the report of the Highway Commission of 1906, there were noticed the Smithton Good Roads Coöperative League, Galva Good Roads Improvement Association, Fulton County Highway Commissioners Association, and Black Hawk Good Roads Association. In addition to these, there have come under the observation of the Highway Commission, the Randolph County Highway Commissioners' Association, which is an association of the highway commissioners of Randolph county, who meet once or twice a year to discuss matters of interest to them. An association of this character is of special significance from the fact that there are so few of them in the State, and that similar organizations should be formed in every county in the State.

### Highway Commissioners' Institutes.

Many have made the suggestion that there should be highway commissioners' institutes similar in scope to teachers' institutes. This idea has been brought out by Mr. E. W. Burroughs in his report as highway commissioner of Fort Russell Township, Madison county, in which he suggests that such institutes should be organized.

There can be no question as to the good that would result from such organizations, and the tax payers should willingly sanction paying the expenses of their commissioners for attendance at these institutes. This topic has already been discussed in the opening chapter of this report.

### Randolph County Good Roads Association.

The following account of the Randolph County Good Roads Association was written by Mr. W. L. Hylton:

Highway commissioners and their clerks are eligible to membership and have a voice in the proceedings. There are fifteen districts in the county; therefore, there should be sixty members. The association is headed by Joseph W. Wood, district 6, president, and Lawrence H. Pautler, district 9, secretary. These gentlemen are both of recognized ability and progressiveness and with proper assistance there is no doubt that they will awaken the citizens of the county from the lethargy in which they have so long lain with respect to this vital proposition—good roads. The objects of the association are:

1. The county commissioners to assume the expense of erecting and keeping in repair the bridges and their approaches throughout the county.
2. Uniform poll tax throughout the county.
3. To infuse into the citizens of the county a proper appreciation of, and a pride in, good roads.

Is there a citizen of our county who can not say that the objects to be attained are praiseworthy? Is there a citizen of the county who will refrain from lending his assistance for the accomplishment of the desired object? We hope not.

Mr. Hylton also writes this account, which appears in the Chester Herald of January 31, 1908, of the meeting of the association which was held at Evansville:

Those present at this meting were: Judges Caldwell and Eggerding, County Supervisor Gant, District No. 1 was represented by Orrie Caldwell; 5, Chas. McKelvey, Otto Schultze, Jas. R. McMurdo; 6, Joseph Wood, Has. R. McMichael, R. L. Mains; 9, Elmer Sloan, W. P. Gray, Lawrence H. Pautler; 11, August Wilkleman, Jacob J. Renner; 12, Michael Roth; 13, Jule Currat; 15, R. P. Cox, W. N. Cox.

Aside from the above named, there were perhaps one hundred and fifty visitors. Should you, as a commissioner, not find your name in the above list, try to arrange to attend the meeting at Sparta in March. You, as a citizen, if your commissioner is inclined to ignore these meetings, use your influence to get him to go, and go yourself. You will be amply repaid. It is hoped that the time will soon come when the commissioners will be allowed the time they spend at these meetings.

It will be well to remark here that this movement has come to stay in some districts and they propose to keep the meetings in the districts where there is an enthusiasm, or, in other words, where they are wanted. So if you want to get warmed up you will have to go to the fire, it will not be brought to you. If you and your district do not get warmed up with the movement in the course of a very few years, you will have to be ashamed of living in a back-number district.

Furthermore, we would like to see the several newspapers of the county send a representatives to these meetings. Give your readers a write up of the proceedings. The papers are recognized as being in the forefront of our educators and are capable of doing much good in this common field.

The dinner hour being over, the convention reassembled and took up the program which had had been prepared by the committee, L. Y. Pautler, Elmer Sloan and Michael Roth.

The secretary read a telegram from the Hon. Chas. S. Luke, stating that he was unable to be present on account of illiness. Mr. Luke was to address the convention on road law.

Hon. Wm. Schuwerk was then called to the platform and it was here that the real feast of the occasion began. We earnestly wish that every taxpayer of the county could have heard Judge Schuwerk and Mr. Johnson, the State engineer, who followed him.

## Galva Good Roads Association.

This association is carrying on vigorously the work that it began a few years ago, and has succeeded in maintaining in the vicinity of Galva, a better condition of earth roads than can be found in general about any other point in the State. Not only the farmers round about Galva, but the business associations in Galva feel the benefits of the work the association has carried on, as it has been no small means of advertising Galva. The cut shown in Plate I was inclosed with the report of the Galva Good Roads Association and shows a visiting delegation from a neighboring town, who made the trip especially to inspect the roads about Galva, and investigate the methods of the association. This delegation was from Kewanee, and as both Kewanee and Galva are small towns, the number of automobiles shown in the picture is significant of changed traffic conditions taking place in the country districts.

## Report of the Galva Good Roads Association.

(By W. O. Houghton, President; E. S. Dean, Vice President, and A. F. Dean, Secretary.)

The Galva Good Roads Association is pleased to make a favorable report of the work accomplished for this year. One of the principal things that has favored better work and more of it has been the old labor system. This has brought about much more systematic work, and the greater part of the work has been done at the proper time—the spring of the year. Our road association feels that the practice by road commissioners and farmers of doing so much of the work in the fall can not be too strongly censured, as is shown by the results in our own township as compared with those in the surrounding townships.

The amount of grading done this year will approximate 25 miles. This, of course, includes a greater part of the road graded last year, which was not completed, and required more work to perfect the grade. A great deal of the grading was done with the engine and the heavy road grader, but as much as three miles of the road was graded with the plow and slip, making, where this work was done, a perfect grade, and as this kind of work was done on the worst pieces of road, the change was very marked.

One of the difficulties that is encountered in establishing the proper grade is to get men with the correct conception of good grades. Our experience would seem to indicate that a great many of our roads are too wide between the ditches. This usually makes what is known as the shallow ditch, and as a rule, after a rain, leaves the road soft ten feet from the ditches. Our best roads, where grades have been finished, are those having the bottom of the ditches 30 inches below the crown of the road.

To construct the proper grade with the grader is something that should not be intrusted to any but experienced men. Maintaining the properly established grade with the drag should not be trustd to inexperienced men without proper instruction and supervision in its use by the road officials.

Marked improvement is noticeable in the roads compared with last year, these roads holding up under the heaviest traffic a few hours after a rain. Low lying pieces of road where the water level was near the surface, and where the proper grades have been established, are good, if not the best, portions of our road. This being the result of thorough work in these places in grading, dragging and under-draining.

Interest has been aroused in the surrounding towns and cities in the work of road improvement. Our county newspapers have been filled with editorial comment commending the results accomplished here. Delegations of citizens and road officials from other places have been here to inspect our roads, and have gone home enthusiastic over Galva's good roads, not only over the grades and smoothness of our roads, but also over the fact that no weeds were allowed to grow, and the systematic care given to them in every respect. On all of the Galva roads where weeds have been cut, and no rubbish allowed to remain since the organization of the good roads movement, the highways are covered, outside the traveled surface, with a heavy sod of mixed grasses which have come in spontaneously because the weeds were never allowed to reach any size.

Another improvement in road work at Galva has been the use of concrete work in bridges and culverts. This work for the past year was confined to the smaller bridges and culverts, in some cases reinforced, and in others not. Two carloads of crushed rock of about 40 cubic yards each were used this year, the rock furnished by the Highway Commission, freight charges being paid by the town. The work was done entirely by local workmen at an average cost of about $8.00 per yard.

The concrete work so far completed in Galva township lacks one thing that our road association thinks should be added, *i. e.*, an effort to give decorative finish. No permanent work of this character should be without an appropriate finish as the additional cost would be comparatively little.

Our commissioners plan in the coming year to put the dragging of the road upon a cash basis, the same as grading or any other work. Contracts will be made with the farmers upon the outlying roads upon the following basis:

Each individual to make one-half or not more than two miles, the latter preferred, and the contractor to be held strictly accountable for the dragging of the specified distance, according to the following scale of wages:

Fifty cents per hour for man and two horses.

Seventy-five cents per hour for man and three or four horses.

The dragging year to begin January 1 and end December 31. A maximum limit, however, of $10.00 per mile per annum being placed in the contract. This, of course, is experimental in the matter of wages, as we as yet have no data wherewith we are able to fix fair wages for labor performed, but it is believed that $10.00 per mile or less from year to year will be fair compensation.

One of the innovations in road work for the past year was the construction of model half miles of road, making as far as we were able at the time this was undertaken model grades, ditches and side embankments. The plan was to have one of these model half miles on each side of the main traveled roads into town as an object lesson so that "all who run may read." Unfortunately but two of these model half miles were constructed, and perhaps not with the completeness of detail desirable, but for the coming year this matter will again be taken up and an endeavor be made to construct these model stretches upon all the main roads.

We find that there is urgent need of familiarizing people with the proper methods of driving upon these dragged roads. People drive indiscriminately across the roads in wet weather, taking no care to travel in one track when the roads are muddy, thereby increasing the difficulty of smoothing the roads with the drag.

The new road law, placing a fine for driving on smoothed portions of the road when the surface is soft, and where there is room to travel on the side, is practically unknown to the farmers, and it is the duty of the farmers' institutes and the road associations to bring this matter to the attention of the traveling public, and, if necessary, make a few examples by enforcing the provisions of the law.

So satisfactory has been the work accomplished by the Galva Good Roads Association and the highway commissioners in this township that the Galva Commercial Club at its meeting December 16 adopted the following:

"*To the Galva Good Roads Association and Highway Commissioners:*

GENTLEMEN—The Galva Commercial Club at its meeting December 16 last, in considering those things that are contributing to the commercial welfare of our city and to the pleasure of our citizens, as a representative organization, wish to express our appreciation of the work accomplished.

We feel that in addition to the immediate commercial value of the work, the publicity given Galva as a center of road improvement will materially aid this club in bringing about a greater appreciation of the city's other attractions. For this, also, accept our thanks.

As a further token of our appreciation, please accept the enclosed check for your road prize list, and a tender of our hearty coöperation in the future.

Yours truly,

V. L. SHORT,
W. S. MCCLINTOCK,
M. M. FORD,
*Committee.*

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REPORT OF SMITHTON GOOD ROADS LEAGUE, SMITHTON, ST. CLAIR COUNTY.

(By Dr. G. G. Bock, President.)

I take pleasure in reporting to the State Highway Commission some of the difficulties encountered, methods used to overcome them, and results achieved directly and indirectly through the efforts of the Smithton Township Good Roads Coöperative League.

In its investigations, it found that lack of interest or apathy on the part of persons who use roads and wrong methods in working them, and especially the practice of building wooden or poor iron bridges which are not only inadequate to stand the increased traffic of the age but are costly and require constant repairs, were some of the principal obstacles that stood in the way of securing better roads.

While the league has made no object lesson in road construction, it has secured practical results by agitation. From time to time it printed and distributed letters bearing on the benefits resulting from the proper use of the road drag and the advantages to be gained by the construction of substantial concrete bridges and culverts. Another and principal advantage gained was the election of three (3) highway commissioners who are members of the league and are in sympathy with its work and are willing to coöperate with the State, county or any organization that will assist in securing good roads.

Through their efforts and direction, with the assistance of the State Highway Commission, they erected five (5) concrete bridges during the last two years; two of which are of the reinforced flat top type, and three are arched bridges.

The State commission rendered valuable assistance in the way of sending an inspector who made a survey of the various bridge sites, executed blue prints and bill of material needed, and later sent a man to superintend the construction until completed, free of cost to the township.

The macadam required was furnished by the county work house. All of the macadam, sand, cement and steel required was hauled from four to seven miles. In addition, they erected a 34-foot bridge on substantial concrete walls or abutments 14 feet high. They ascertained later that the superstructure of this bridge could have been made of concrete and would not have cost more than steel.

The commissioners have constructed and have in use 12 wooden and one steel Peerless drag. The wooden drags cost $3.50 and have done more to keep the roads in good condition than any other device or implement tried. The idea of making good or even better roads out of mud with so simple a device, especially when the roads were sloppy, was not received with favor from the start, but is now conceded by all, except those who can not comprehend the philosophy or out of stubbornness fail to be convinced.

To facilitate building arched concrete culverts and bridges, the commissioners have 4½, 6 and 12 foot arched forms with other necessary lumber on hand so that when a wooden culvert requires to be replaced it can be done without unnecessary delay. The forms can be used a number of times and save expense and delay or having a new one for each bridge or culvert. One of these forms has been used three times and can be used a number of times before a new one is required.

The commissioners have inaugurated or adopted the following system in their efforts to improve the 45 miles of roads, viz: Grade five miles in each district, build one or as many concrete culverts or bridges in each district as funds will permit, and drag roads as often as conditions of soil will allow.

It is the firm belief of the league that the slow progress made in road and bridge building is largely due to poor methods or lack of method. Another and important obstacle standing in the way of better bridges is the law that prohibits commissioners from building bridges costing over $75.00 except in an emergency.

This law should be amended so as to empower commissioners to build bridges costing $800 to $1,000 under the supervision of the State. Many small concrete bridges or culverts could be built in this manner, cheaper and better than by any public letting or contract.

Another way of saving thousands of dollars to the people of the State would be to have the State Highway Commission make a survey of all the bridges and culverts in a township, estimate cost, execute plans and specifications and let all the work to be done to the lowest bidder under the supervision of the State engineer or superintendent. The person or persons getting contract for building all of the bridges could build them much.

cheaper than if one or two were built each year, as a decided reduction could be secured on cement and steel, if built in this manner. The rock or macadam or gravel required could be secured from State or county work house thereby diminishing the cost.

The necessary funds could be secured by the township issuing interest bearing bonds, which could be floated in nearly every township. The roads could be improved along corresponding lines.

No commissioner of highways should undertake the erection of any concrete work or bridges until he has previously informed himself in regard to all the details of the work and especially to the quality of cement, sand and other material, as carelessness or oversight in regard to the selection of these, or carelessness in regard to right proportions or mixing may cause the work to be a failure and result in loss, and do the cause great harm.

The State Highway Commission stands ready to educate all who are willing to learn. Why not avail ourselves of this advice and avoid the mistakes of the past?

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## Farmers' Good Roads League.

(By H. H. Gross, Secretary.)

The Farmers' Good Roads League of Illinois was incorporated on the 10th of December, 1907.

The officers and directors are as follows: A. P. Grout, Winchester, president; Jacob Zeigler, Clinton, vice president; H. H. Gross, Chicago, secretary and treasurer; B. F. Wyman, Sycamore; J. H. Kincaid, Athens; H. G. Easterly, Carbondale; C. P. Reynolds, editor "Prairie Farmer," Chicago; A. H. Sanders, publisher "Breeders' Gazette," Frank H. Hall, Aurora, directors. Messrs. Grout, Wyman, Reynolds, Hall and Easterly are directors of the Farmers' Institute of Illinois.

The object for which this league is formed is stated in the charter as follows:

"To promote the building and maintenance of good roads, to conduct a campaign of education upon the construction and care of highways, to seek legislation that will place a portion of the cost of permanent improvements on all property of the State, to seek national and State aid in road building. The charter provides that six of the nine directors must be farmers."

The membership fee is fifty cents per year for single memberships, but where auxiliary leagues are organized and affiliated with the Farmers' Good Roads League, the yearly membership is twenty-five cents. Such organizations are being formed in JoDaviess, Stevenson, Greene and other counties.

The league has furnished for publication to papers throughout the State, bulletins on the question of highway improvement, maintenance and building of hard roads, and the like. The league holds that the only solution of the road problem is the building of permanent hard roads upon the main highways of the State, and has demonstrated and is demonstrating that this can be done without material increase in the taxes upon farm property under the State aid plan, which is in successful operation in fifteen other states.

The secretary is an experienced road builder and a well known writer upon the subject of highway improvement. The league holds that the highways of the State are as much public property as the State house, and the practice that has obtained for the last fifty years of placing practically all the burden of road taxes upon the farmer, is unjust and indefensible; as the roads are public property the public should be charged with the building and maintenance of them. Farm property is less than one-third of all the taxable property in the State and if the burden were distributed over all property it would be comparatively light. It is the purpose of the league to conduct a campaign of education until the people will understand the road question and all its bearings and will place the burden where it belongs.

Any citizen is eligible to membership, notwithstanding the control of the board must be in the hands of farmers.

Its source of revenue is from membership and voluntary contributions. The executive office is No. 6001 Indiana avenue.

It is the desire of the league to have local organizations formed in the various counties by those who believe that the roads should be improved, and a good road means one that is hard, smooth and useful 365 days in the year. The league will do all it can to encourage the improvement of earth roads with a road drag, scraper, etc., as a step in the direction of better highways, but it does not regard such work as more than a temporary expediency.

A. Smithton Township, St. Clair County. Concrete arch built by Smithton Township Good Roads League.

B. Blue Ridge Township, Piatt County. I beam bridge with concrete floor, built by Township Commissioners. A good bridge but not as cheap or durable as reinforced concrete bridge.

## Reports From Local Highway Commissioners.

Probably no better conception of the existing road conditions and difficulties with which the local commissioners have to contend could be presented than by reports from the commissioners themselves. Some attempt to do this is made in this chapter, which is composed of a few reports received from highway commissioners in various parts of the State. As it would not be possible to have embodied in a single volume reports from all commissioners, even if they had chosen to make them, and as such a voluminous amount of material would have defeated its purpose, it was thought best to give but a few reports. Therefore, a letter was sent to some of the commissioners, who it was known would be willing to give their experience and who had in many instances accomplished especially good work. All of the commissioners who were asked to submit reports have done so, and what is given here as their experience is the experience of many other commissioners.

Many of these reports contain suggestions of great value and, coming as they do from men who have had actual experience in dealing with local road administration, they should have corresponding weight.

These accounts can well be read in connection with the chapter on road organizations, which contains descriptions by the officials of these organizations of the work they have accomplished. The report of the Smithton Good Roads League may be considered practically the report of the work of the highway commissioners, as the president of the league is also chairman of the local board of highway commissioners.

This chapter is also in a measure, supplemental to the one on "Present Method of Road Administration" and on "Special Road Conditions," found in the first annual report of the Highway Commission.

The first report is by James Blanchard, highway commissioner of Waukegan township. Mr. Blanchard has been highway commissioner continuously for the past thirty years and he is, it is believed, the dean in years of service of the highway commissioners of the State. It is also subject for remark that one of Mr. Blanchard's colleagues has been in office for the past fifteen years continuously. If this practice were more general, there would be today vastly better road conditions

in a majority of the townships of the State. Plate 4, figure A shows a road built in 1907 under the personal supervision of Mr. Blanchard.

The report from Union county is of particular interest from the fact that it is the only county that is under the optional road act of 1901. The essential feature of this act is that the roads in the whole county are under the immediate charge of three county commissioners.

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### Report from Waukegan Township, Lake County.

(By James Blanchard, Highway Commissioner.)

I have served as commissioner of highways in the town of Waukegan, Lake county, from 1878 to the present time. I have been treasurer of the highway commissioners for about twenty years and still hold the office. Our township has about forty miles of road, and is divided into three districts, a commissioner being elected for each district. At the commencement of my term, we worked under the pathmaster's system. Work was generally done on the road when there was nothing else to do, a little dirt was scraped here and there, a few loads drawn with wagons and leveled with a hoe.

The first tools we had were wooden scrapers, with steel blades; the next, tongue scrapers. Then, we thought we had a great thing because we could level the road.

The roads in our township are not laid out on the section lines; they are very crooked and it was difficult to straighten them. They had been worked from one side of the highway to the other.

After a time we did away with the pathmaster; had the tax in money; then we began to straighten the roads and get them in the middle. We hired the help to work the road at a proper season and then we obtained much better results.

About that time we purchased a two-wheel grader, one of the best machines of that period; a little later we bought the four-wheel grader; then we got the roads in good shape for graveling.

Nine years ago we graveled the first half mile of road done in the town, with crushed stone from Racine, having no material in this town. It cost $1.10 per yard, delivered at the depot, hauling and leveling extra.

Since then we have used some slag and gravel; the slag costing on an average of 95 cents per yard and the gravel about $1.00. The slag comes from Chicago and the gravel from Libertyville.

The stone we used this year came from Joliet, being furnished by the State. We built the first stone culvert in 1891. Having no money, we gave our individual notes. The people thought we were foolish to undertake such a thing, but the next year we raised the tax, collected the money and paid the debt before the public realized it. And today, the culvert is as good as when built, no repairs being made on it except pointing up once. It is a six foot culvert with a stone bottom, 50 feet long with wing walls. The stone and mason work cost about $1,200; extra help was paid separately.

We have put in two small ones since and several abutments with stringers across, and they have all given perfect satisfaction.

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### Report From Union County.

(By Samuel F. Davie, County Commissioner.)

First, the material we have for making roads varies much, as in the west side of the county we have Mississippi bottom land that is made land; some of it is sand and the rest of it is black, swampy and waxy. This we have improved by grading and graveling. This process is very slow, as we only have a tax of about $20 per mile over the county. We have about six miles

of the worst graveled, and one mile of crushed stone and four miles graveled that is solid road. The center west half of the county is broken with clay hill and creeks with gravel bottoms, this is being improved with grading, draining and graveling.

The east half of the county is hilly with clay soil, with a great many of the hills of limestone or sandstone. It is very hard to get any material that will make a smooth road bed that does not wash off and leave the ledges of the rock bare and very rough. Despite a limited amount of money the roads in general have improved in the last twenty years. We have been working for two years under the law approved May 10, 1901, and we adopted the same by a vote. It is not giving general satisfaction because the people expected too much of it and we have had two very wet summers and heavy rains to wash our work off before it had time to pack.

I think a law providing for bonds to be issued to build permanent roads, with the personal and real estate tax for a period of say twenty years, and providing for the adoption of the same by the vote of the people would be an improvement; also I think that there should be found a way to make sure that the work would be done by a competent man; let the poll tax do the repair work and keep up the roads running to the main roads, and let the personal and real estate tax build the main traveled roads.

Our personal and real estate tax in this county amounts to about $10,000 per year. I think the bonds could be made payable as the tax is collected.

Seven-eighths of a mile of stone road was built by me in Road District No. 9, Union county, Illinois, in the winters of 1906 and 1907; I had the road graded up in the last week in August about 2½ to 3 feet above the level of the ground, the country being bottom land and swampy. Before the stone arrived, the road bed was covered with water so that we could not travel on it and where the water was low enough to get on the dump we tried to make the grade to specifications, but found that it could not be kept in shape; so we commenced hauling stone from the car and building on the end next to the switch. We put one load in the center of the dump and did not spread it any for the final course.

We dumped the final course out in the mud about two hundred yards and then we dropped back and commenced with our second course; dumped it in the center as before, and when the teams running over it did not fill the ruts, we had a man spread it and keep the ruts about level.

The weight of the wagons caused the wheels to press out the side of the embankment and made a protection of earth to keep the stone from spreading and rolling too far. In this way, we made most of the road about eight feet wide and about eight inches deep, except about one hundred and fifty feet that was water and mud that we could not drain off. On this we experimented by hauling boulders from the size of twenty-four inches in diameter to as large as we could handle and placed them to make a firm foundation; then put stone on top of them, which made a good road. For a short distance we put stone in the mud and water, a yard in a place to cover eight feet wide and ten feet long; then covered the stone with sand and put more stone, then sand, then stone, which cemented the stone and made a good road.

In the worst place, we put in about one foot of wheat straw, then put on sand to weigh it down; then put on the eight inches of stone. This appears to be the best value of any of the work so far as we have tested it.

This road has been finished about nine months and has been covered with water several times since being completed, and stands just as we finished it.

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## Report From Fort Russell Township, Madison County.

(By E. W. Burroughs, Highway Commissioner.)

Our township (Fort Russell) in Madison county probably has as many soils, as great a variety of prairie, creek bottoms and hills and as large an assortment of all kinds of bridges and culverts as any township in the State. Roads and bridges become impassable at times, lots of free advice offered with

plenty of 'cussin' and criticism; about the same old tax levy annually, used mostly for repairs and 'working' the roads when our constituents wished, and, when necessary to put in a new bridge, accepting the lowest bid which usually meant the cheapest structure, sums up the general road conditions in our township.

Several years ago when the "good roads" movement was being discussed, our people began to "sit up and take notice." We put in a few good steel bridges, heavy steel culverts 20 to 30 feet long, and large enough to carry the water, in place of all wooden culverts and small bridges, also used some sewer pipe laid in concrete where drainage conditions would permit. The past year we put in one 45 foot reinforced concrete bridge, 20 feet wide, and a number of smaller ones from two to six feet in span which were designed by the Illinois Highway Commission.

We have taken up the road matter beginning with the main traveled ones, first using a scraper to dig out and open ditches, then placing dirt in holes where needed, shaping up the road properly and doing the rest with the drag. Many of our enterprising citizens keep the roads between their property and their market town dragged without cost to the township. Much of this work we have been able to do with the advice and assistance of the State Highway Commission.

After some experience and study, it appears to me that some change in the road law might be advisable. I would suggest that three county commissioners be elected, the same as other county officials; this board of commissioners to have power to appoint a county engineer, also a superintendent in each township. The county commissioners and engineer, with the counsel and advice of the State Highway Commission, to have entire charge of all county roads and bridges. Also have a two days' institute annually under the auspices of the State Highway Commission, allowing expenses and per diem to county commissioners and engineer.

Another plan would be for each township to elect a commissioner who would be *ex-officio* road superintendent, then the commissioners elected from each township to form a county organization of commissioners, electing a president, vice-president and secretary who would constitute an executive committee and have charge of letting of all contracts in any township with the aid of the commissioner from that township and the county engineer; the engineer to be appointed by the county board. The county engineer should have charge of all structural work. The county commissioners and engineer to have on all structural work the advice and approval of the State Highway Commission, before contract is entered into.

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### Report From Bement Township, Piatt County.

(By G. L. Burgess, Highway Commissioner.)

As to the problems and difficulties we have to meet as road commissioners, people in general are satisfied with doing just a *little* better than they have been doing, and when road commissioners try to do considerably better, a general howl goes up which usually puts a quietus on improvements proposed, for as a rule the commissioners, like most politicians, are playing for re-election. I was not playing for re-election and knowing about the State Highway Commission, I went after all the assistance possible and succeeded in getting in nearly two miles of experimental earth roads, which are proving entirely satisfactory and have converted the worst kickers, people that nothing short of showing would convince, that it is possible to make our earth roads very much better and with proper care fairly passable in the worst months. I firmly believe that without the creation of the State Highway Commission, it would not have been possible to have made this piece of road as our funds would not justify expenditure for costly machinery for experimental purposes.

This experimental earth road was built under the supervision of the State Highway Commission. Up to date, December 12, 1907, it has proved entirely

A. Bement Township, Piatt County. Experimental earth road. Machinery used in construction, roller provided with flat ended spikes or spuds to compact the earth.

B. Bement Township, Piatt County. Experimental earth road. Shows finished grade of road and side ditch.

satisfactory. A few days ago there was a hard all day rain; the following day a horse and buggy could trot over the experimental road without difficulty, before it was all a horse could do to pull the buggy through the ordinary road. Whenever it has been possible, we have kept the drag at work on this road but have not been able to use it very successfully so far, as we find the road surface is such that it would probably require a leveler to first fill in the tracks so that the traffic will pack it hard and leave no ruts to hold water from the next rain. While it is not expected that this road will be without mud during the winter and spring it is thought that it will be enough better to pay its cost. (See plate 3.)

Now as to what our commissioners could do next year if given an opportunity. They could put in 29 miles or more of such roads as built last fall, on the same terms as before, at a net cost of less than $200.00 per mile. We have completed north of town a concrete culvert with concrete wings at a cost of $325.00. Will put in concrete 24 inch sewers across our experimental road and if this pleases me as well as I expect, will replace all broken sewers with concrete.

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## Report From Joliet Township, Will County.

(By Geo. W. Haywood, J. S. Boyd and Robt. Holmes, Highway Commissioners.)

In speaking of the difficulties which have met the commissioners of highways of the town of Joliet, in the construction of stone and macadam roads, we would first note the various sources of material. Previous to the Act of the Legislature creating the State Highway Commission and placing at the disposal of the commissioners of the town of Joliet, their pro rata amount of the road material, our source of crushed stone for improved roads was from the various private stone crushers in this vicinity and our own two crushers. As compared in cost and quality with that furnished by the State Highway Commission, it is but fair to say that its cost was almost double and its quality inferior.

The funds available for the construction of roads are, of course, limited. The decreased cost of material by reason of the State Commission, has enabled our commissioners to construct more miles of improved road, thus accommodating more of our people, while the improved quality of material has made better roads possible, with longer lasting qualities.

One of the principal items of expense in the construction of a road is the transportation of material from the distributing point to the place where the road is being constructed. We, of course, are not informed of the availability of railroads in other parts of the State, but the large number of trunk lines with their varied and extensive switch yards and facilities in our township, allow the highway commissioners to transport the material furnished by the State in cars to much more available points than the stationary local crushers. This feature has also had much to do with more improved and extensive road building in the town of Joliet. This economy in these several material features, has allowed the commissioners of highways of the town of Joliet to enter upon an extensive campaign of good roads, without any appreciable increase in taxation.

In conclusion, we may add that the courtesies and accommodation of your honorable body in furnishing our alloted material at the proper time and in needed quantities, has added materially to our success in the matter of road building." (See plate 4, figure B).

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## Report on Bridges in Blue Ridge Township, Piatt County.

(By J. C. Smith, Highway Commissioner.)

Four years ago, we needed two new bridges. We employed our county surveyor to make plans and specifications and as lumber was very high and poor, we asked him to have concrete floors put on them. We had our letting

with several bidders, their bids ran from $1,800 to $2,300 on two bridges. As we knew no better, we accepted the lowest bid.

When the contractor came, he suggested some changes which did not improve the bridge materially but he thought it would make it more sightly. We consented, and the consequence was that the bridges cost us more than $2,000 when completed.

As this went for our cash at an alarming rate, we concluded we would have to use some other method if we supplied our township with good bridges as fast as the old ones gave out.

The next year we had a letting and bought our bridges punched ready for construction and hired men by the day to put them up. The consequence was we got just as good bridges for $600 as we paid $1,000 for the year before, although labor had become higher.

The next year we bought our steel direct from the mills, bought a drill and punched the steel which was quite a saving. (See plate 2, Fig. B.) This year, we have put up most of our bridges as designed by the State Highway Commission. We have put in ten two foot concrete sewers with heading at each end. These sewers cost us from $25.00 to $35.00 apiece. We have built thirteen concrete bridges from four to eighteen feet long and from sixteen to twenty-four feet wide. These bridges have cost us from $150 to $400 apiece.

We pay our foreman $4.00 per day, he takes full charge—hires teams to haul, hires men to help him and it is not as much trouble to us as to contract our work. If you get a good job from the average contractor, you have to watch him from start to finish, especially if it is concrete work.

We had county aid for one job. The supervisors would not consent to have the work done by the day so it was contracted. As it was in my end of the township, I had to watch the job. I put in more than twenty full days. I think we got a good job.

A. Waukegan Township, Lake county. Limestone road, gravel binder, built by township commissioners, stone furnished by State Highway Commission.

B. Joliet Township, Will County. Maple street. Limestone macadam, gravel binder. Constructed by township commissioners, stone furnished by State Highway Commission.

## Traffic Census.

In the report for 1906 there was an account of the road traffic census which was then in progress. At the time that report was made this work had only begun and it was not possible, therefore, to present a complete outline of this project. There were then 37 traffic stations at which points the number of vehicles passing over certain roads was counted. There have since been added 34 stations, making a total of 71. The location of these stations, as shown on the map in Figure 1, varies widely. It will be seen that they are distributed in practically every section of the State. Attention will first be attracted to the stations shown, by the clusters of black dots in certain localities. It is at these points that either there is more than one station on a given road or observations have been taken on more than one road into a town.

It will be necessary to repeat to some extent the explanation of the method of taking the traffic census which was given in the 1906 report in order that this chapter may be better understood. There has now been completed one year's record at all stations and at a number of the stations nearly two years, so that it is believed there has been collected sufficient data for a preliminary study. The time, however, that could be devoted to this work has not permitted as careful consideration as would be necessary for a complete interpretation of the results.

It will, undoubtedly, be found of value after a lapse of one or two years to have another year's record taken of the traffic at the same stations, for the variation in the traffic at a number of stations where the record extended over a year, shows that one is not warranted in drawing too exact conclusions from the record of but one year's traffic.

### Relation of Amount of Traffic and Population of Nearby Towns.

There are, however, some essential points which only a slight investigation of the results obtained, will prove of interest and value in a discussion of road improvement from an economic standpoint, and confirms the conclusions reached in the discussion given in the 1906 report. The first investigation undertaken was the relation of the amount of traffic over a particular road to the size of the town, in the vicinity of which the road is situated. For this purpose there were selected practically all of the stations which were in the im-

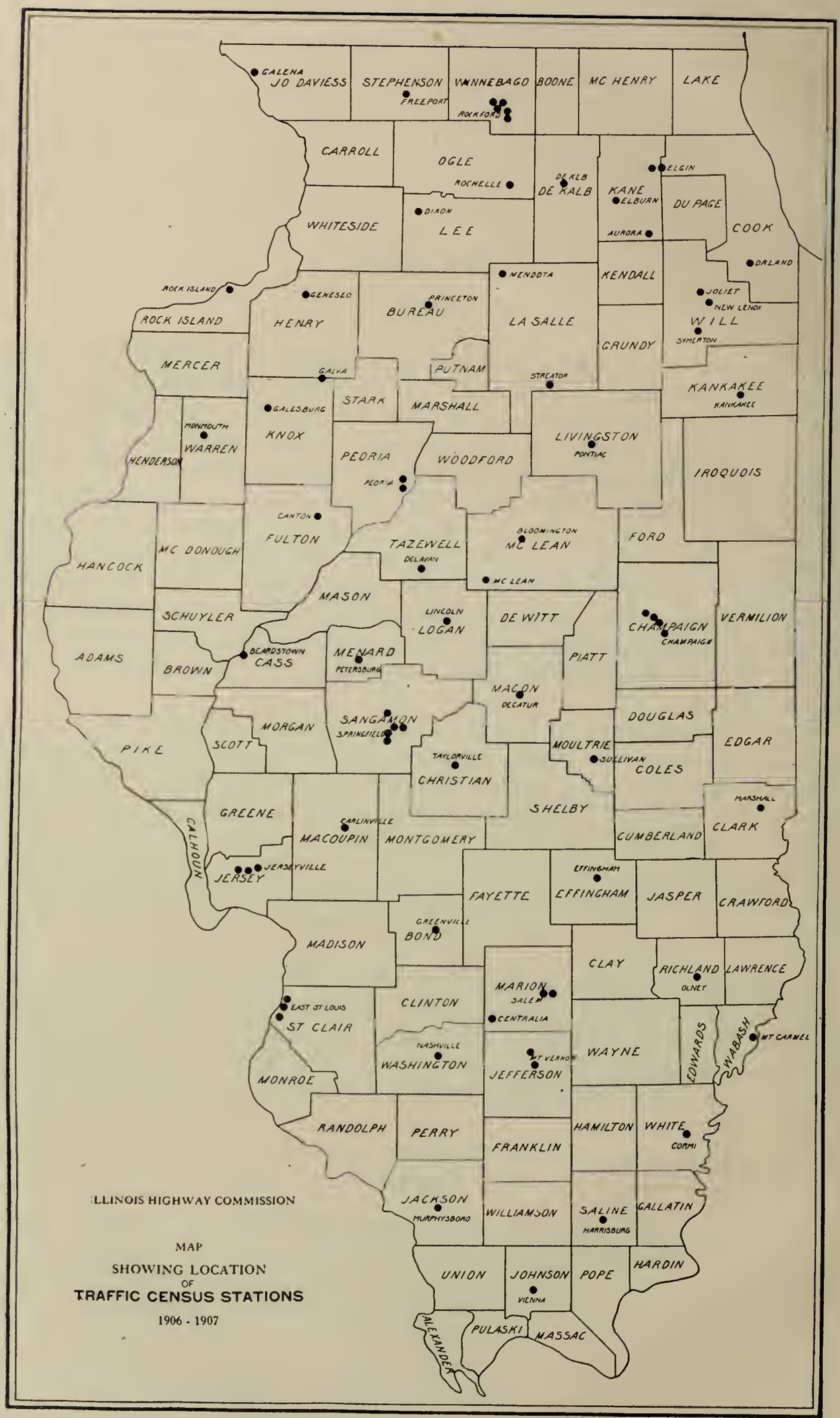


Fig. 1. Map Showing Location of Traffic Stations.

mediate vicinity or on the edge of the towns in question and the daily average of the number of vehicles passing for a complete year obtained, and this average daily traffic compared with the population. This is brought out graphically in Figure 2, which shows the relative population of the towns together with the average daily traffic over the various roads. The towns were arranged in the order of their size, the largest being shown by the length of the vertical lines as

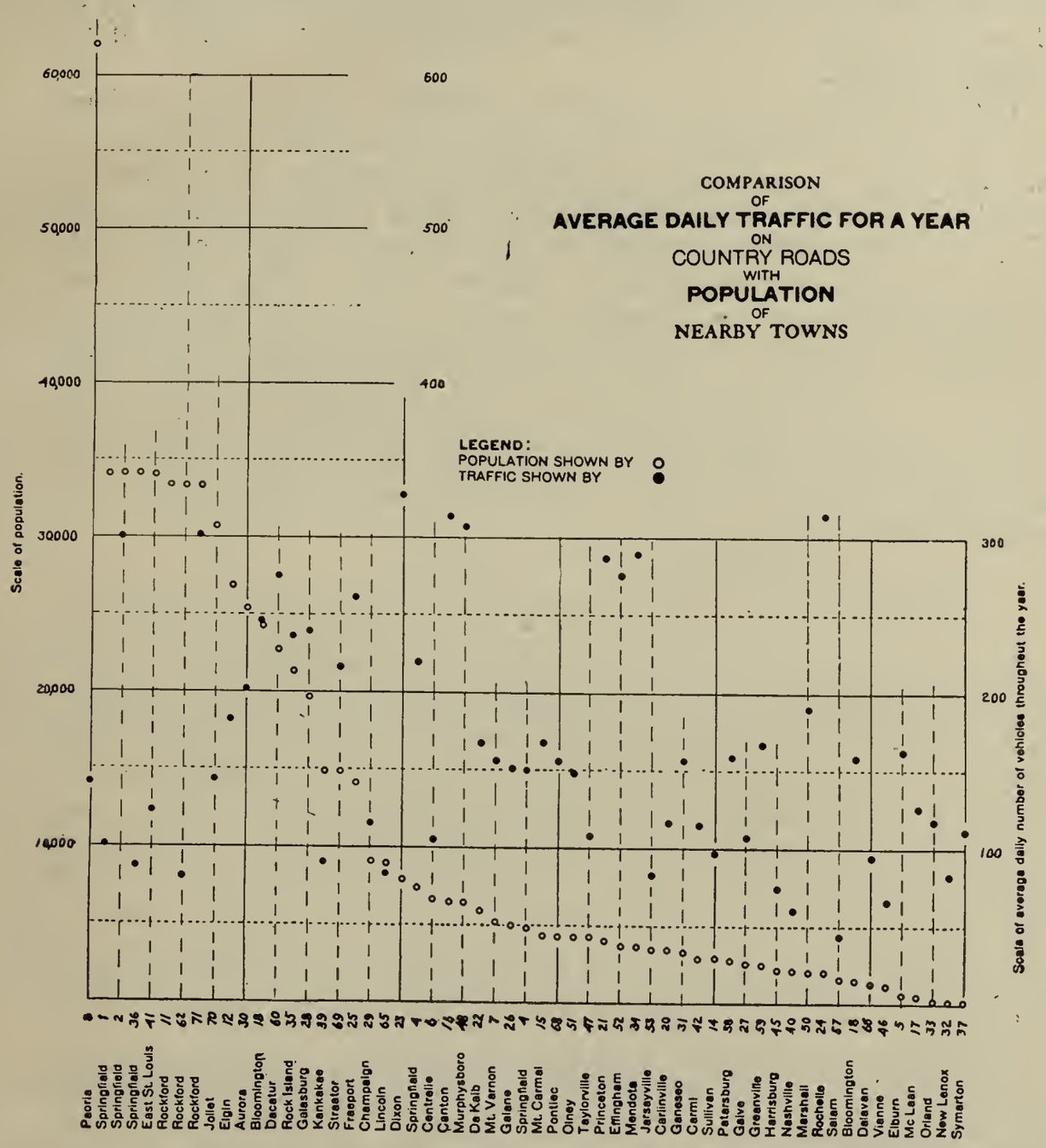


Fig. 2. Comparison of Average Daily Traffic for the Year on Country Roads, with the Population of Nearby Towns.

terminated by open circles. At the bottom of the figure is arranged the number and name of the traffic stations, and reference to the printed list will identify each station. The first station, which is traffic station No. 8, is near Peoria which has the largest population. Next comes traffic station No. 1, which is near Springfield and so on down to traffic station No. 37 which is near Symerton, having a population of a little over 100. In the same vertical line with the open circle representing the size of the population, is shown a solid black dot

which indicates the relative amount of daily traffic. A glance at the diagram will show that roads with less than 100 vehicles are situated near some of the largest towns as well as near some of the smaller. In general, there is apparently no connection between the amount of traffic and the size of the town towards which the road leads.

Inasmuch as in nearly every instance the roads extend into farming country, it would be evident that it is the density of the population in the country and not that in the city which would affect the number of people using a given road and consequently the number of vehicles passing over it.

The conclusion is, that certain individual roads in the vicinity of even very small towns are as important as the roads near larger centers, and inasmuch as a road's worth is in proportion to its use, a community is warranted in expending as much money on certain sections of roads leading into a small village as on certain sections of other roads leading into very much larger cities. The conclusion here stated should not be confounded, however, with the idea that there is no greater number of vehicles going into the larger cities than into a small one for this is not usually true, from the fact that the larger city has a much larger number of roads leading into it; but the fact remains that the individual roads into the larger cities may be not, and oftentimes are not, as much traveled as some other roads into much smaller places.

## Effects of the Condition of the Roads on Traffic.

The next investigation which has been undertaken in a tentative way, is intended to show, if possible, what is the effect of the condition of the road on the traffic over it. This, however, cannot be arrived at conclusively in all cases from the fact that the weather, which is a controlling factor in the condition of the roads, may and does usually, prevent many from traveling the roads, even though the condition of the road might not be thereby affected. It is probable that more logical and more conclusive evidence on this point would be brought out by a comparison of the traffic on individual days, selecting days that were pleasant and at the same time days on which the condition of the roads had been affected by bad weather.

The first comparison is made for average conditions. For this purpose, the average traffic during March 1907 is compared with the average traffic for the summer season. Inasmuch as all the stations on which traffic had been observed did not have complete records for the same summer, a comparison has been made in some cases with the summer traffic of 1906 and in other cases with the summer traffic of 1907. This, no doubt, would have some general influence on any comparison from station to station and would perhaps make some difference in the relative results. It is believed, however, that the results arrived at can be taken as fairly illustrative, and as having an important bearing on the question of the effect of the condition of the road on the amount of traffic.

In order to bring out the results more clearly they have been shown graphically in Figure 3. At the bottom of the diagram each of the traffic station numbers referred to, can be identified by comparison with the printed list. The average daily traffic for each station throughout the year was first obtained and arranged from the largest to the smallest observed, the largest being at the left of the figure and shown by a crossmark. It will be noticed that the variation in the

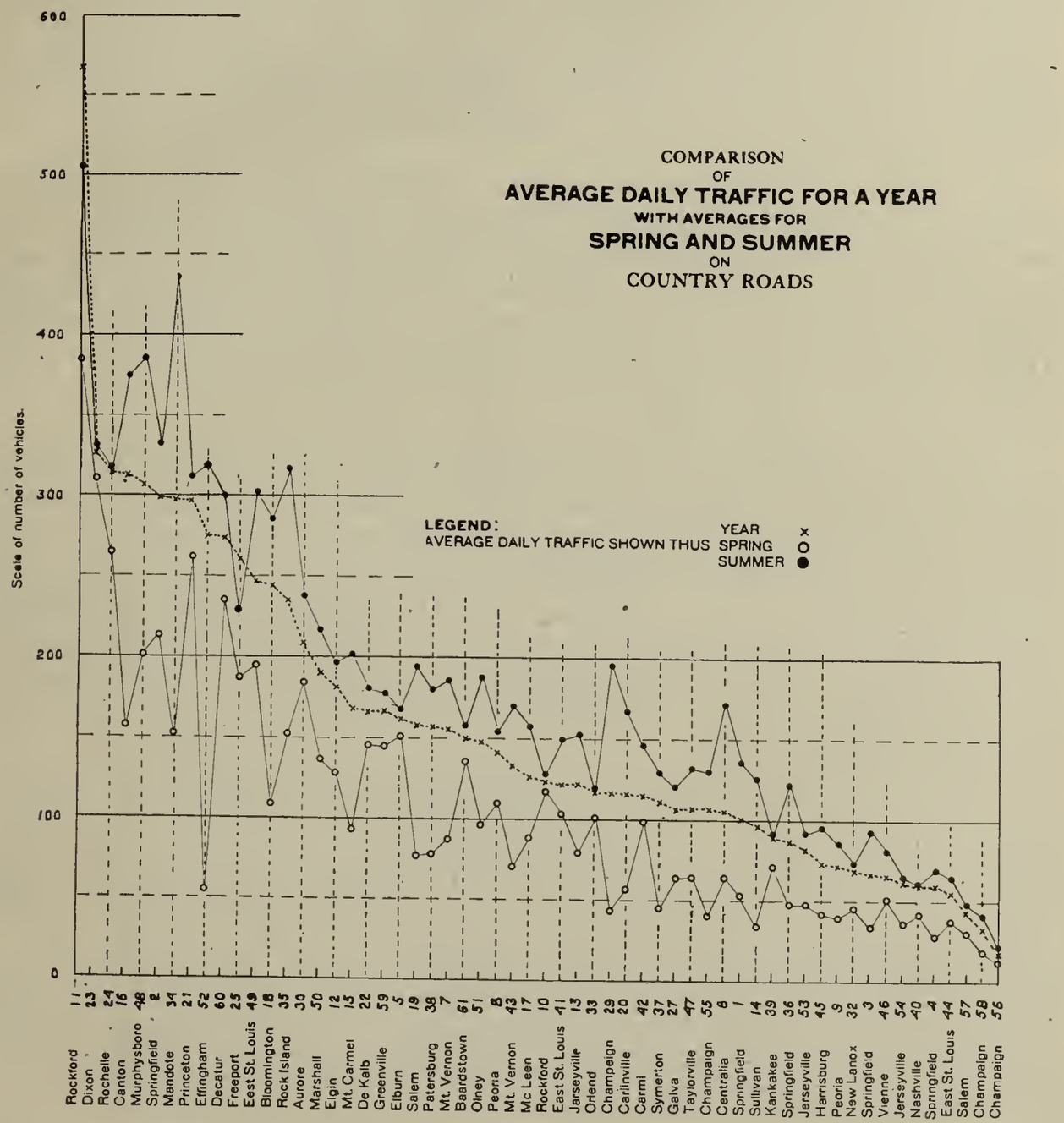


Fig. 3. Comparison of average daily traffic for the year, with averages for spring and summer on country roads.

average daily traffic is from 568 to 18 vehicles a day. To aid the eye a dotted line has been drawn to connect the crosses. On the same vertical line on which a cross has been placed to show the average daily traffic for a year for a particular station, is shown an open circle, which is the average daily traffic during March, and a solid circle, which is the average daily traffic during the summer months. In those cases where the daily traffic in the summer time is very much greater than in the spring, the distance from the solid circle to the

open circle will be larger and farther away from the crossmark than in those cases where the average daily traffic in the summer is more nearly that found in the spring. A glance at the diagram will show that there is a great variation. In some cases, notably that for stations 13, 21, 22, 59, 5, 61, 10, 33 and 39, it will be noticed that the solid dot and the open circle approach very near the cross marks, showing that there is not a great variation in the average daily traffic during the summer and winter. In the majority of cases it will be noticed by referring to the printed list of the stations showing the nature of the roads on which the traffic was observed, that these are gravel or macadam roads and consequently much less affected by the weather conditions.

In a few instances a somewhat curious result will be readily noticed, from the fact that the maximum average for summer as well as for spring are both less than the average daily traffic; for example, at stations 11, 25 and 52. This is occasioned by the fact that the summer months were not the months of maximum traffic on these roads, which occurred during the fall when the traffic was very much greater than at other times.

In order to arrange the daily traffic so that it can be more clearly understood, diagrams have been prepared for various stations, showing the amount of traffic for each day. When comparing the results found in the diagrams showing the traffic for each day with the average results in Figure 3, it should be borne in mind that the average results in Figure 3 for stations 1 to 31 inclusive, give the average daily traffic for March 1907 as compared with that for July, August and September, 1906. For stations 32, 33 and those following, the average daily traffic for March 1907 is compared with that for June, July and August 1907.

It seems fair to draw the conclusion from the actual results shown, that where roads are of such a nature that the weather does not affect their condition, there is a greater proportionate amount of traffic over them in the winter and spring than is generally the case on roads which become extremely bad by reason of weather conditions. It would also be fair to assume that on these roads, which now have a certain amount of traffic in good weather, that, if these roads were improved, there would be a greater amount of traffic during the bad weather, or in other words, the community would use the roads more in proportion as they were improved.

## Through Traffic.

To throw some light on the amount of traffic on various portions of a road, comparison of the traffic at those stations located on the same road will be taken. In the adjoining table is shown the average daily number of vehicles passing certain stations located on the same road, and it will be seen that the amount of traffic three or four miles from a center towards which traffic is moving is very much less than close to town. As was pointed out in the first annual report, it is evident that a community would be warranted in spending on the first mile or two nearest town, four or five times as much as on sections of the

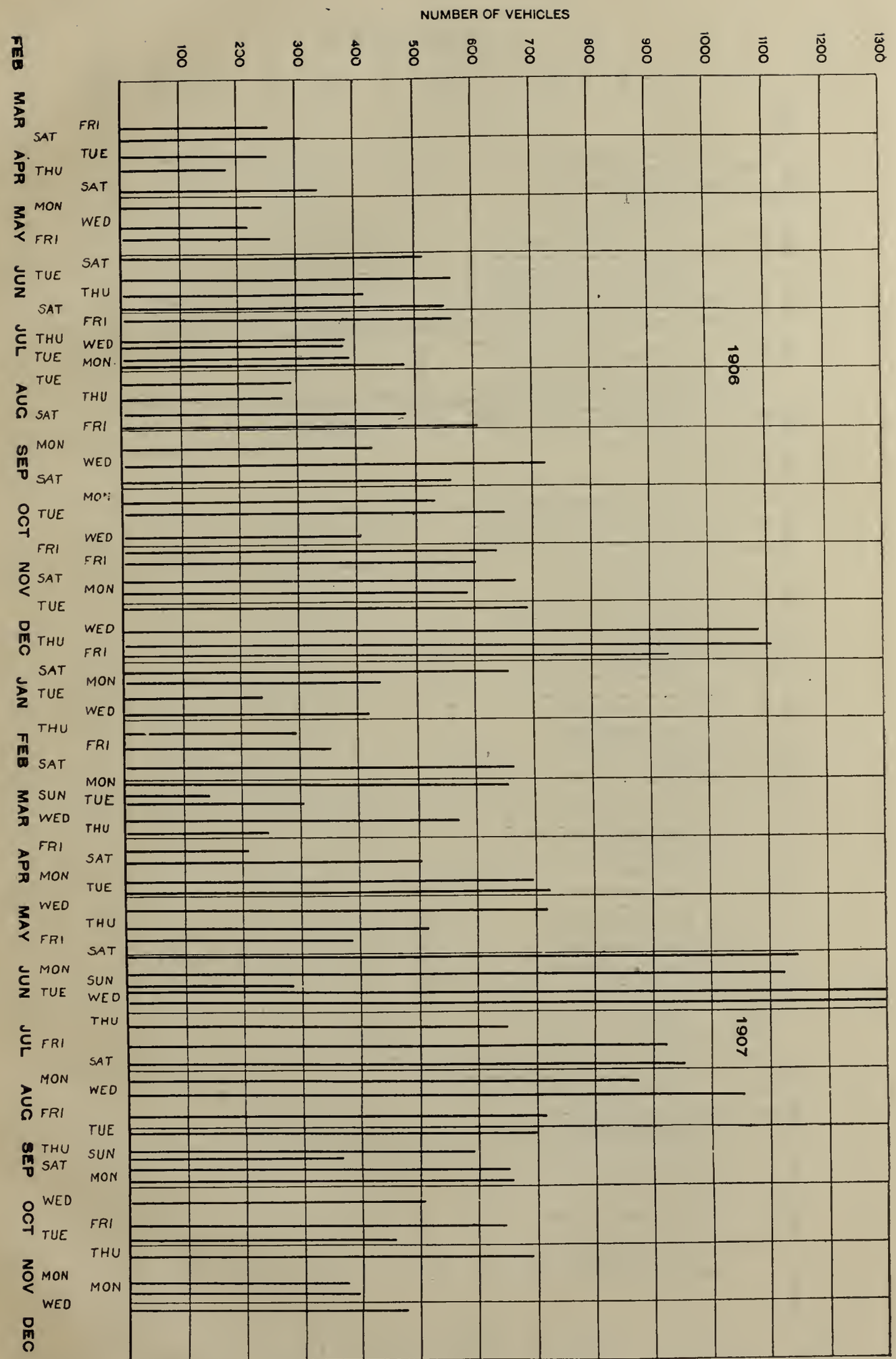


Fig. 4. Record of Traffic at Station No. 11, Rockford, Winnebago County.

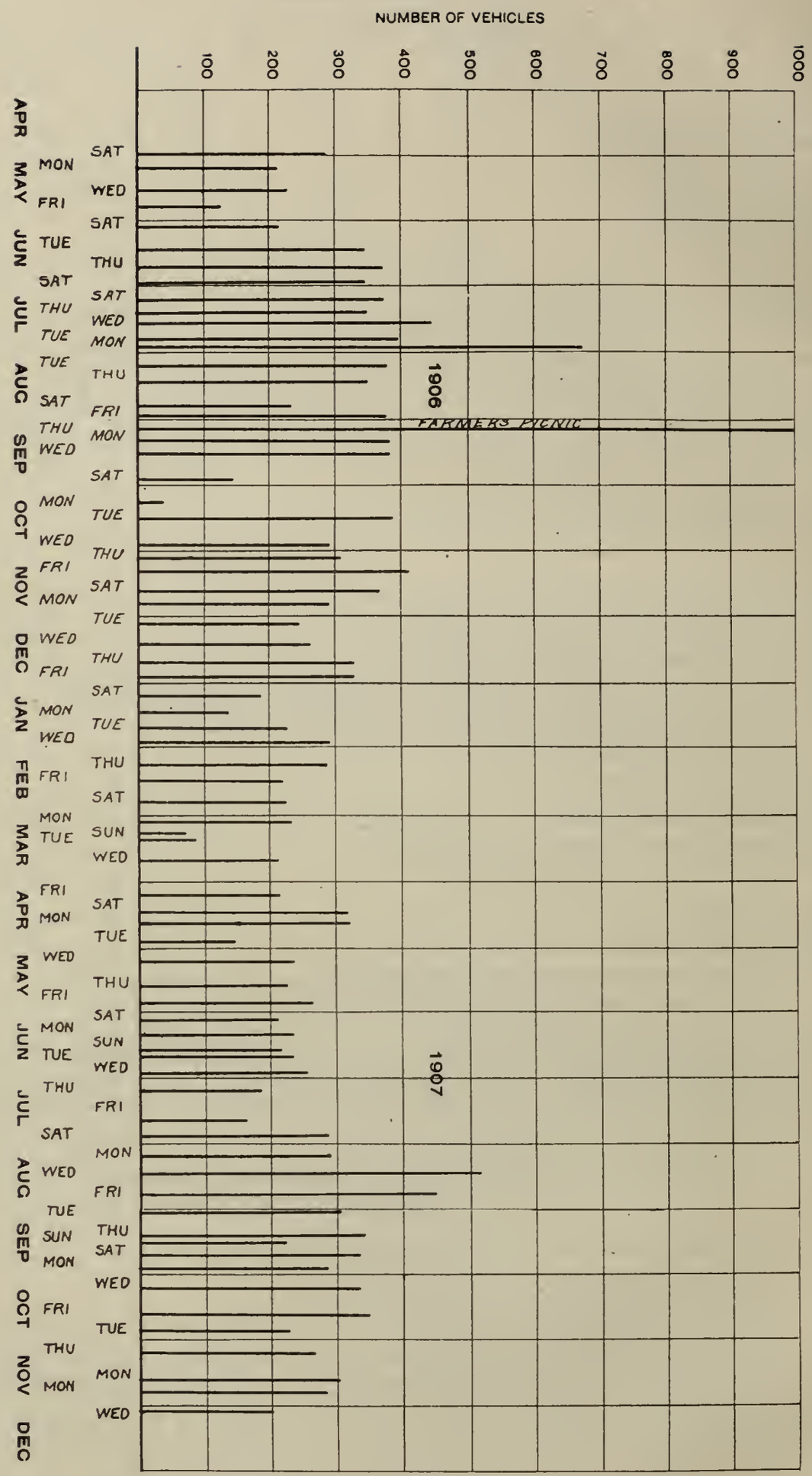


Fig. 5. Record of Traffic at Station No. 16, Canton, Fulton County.

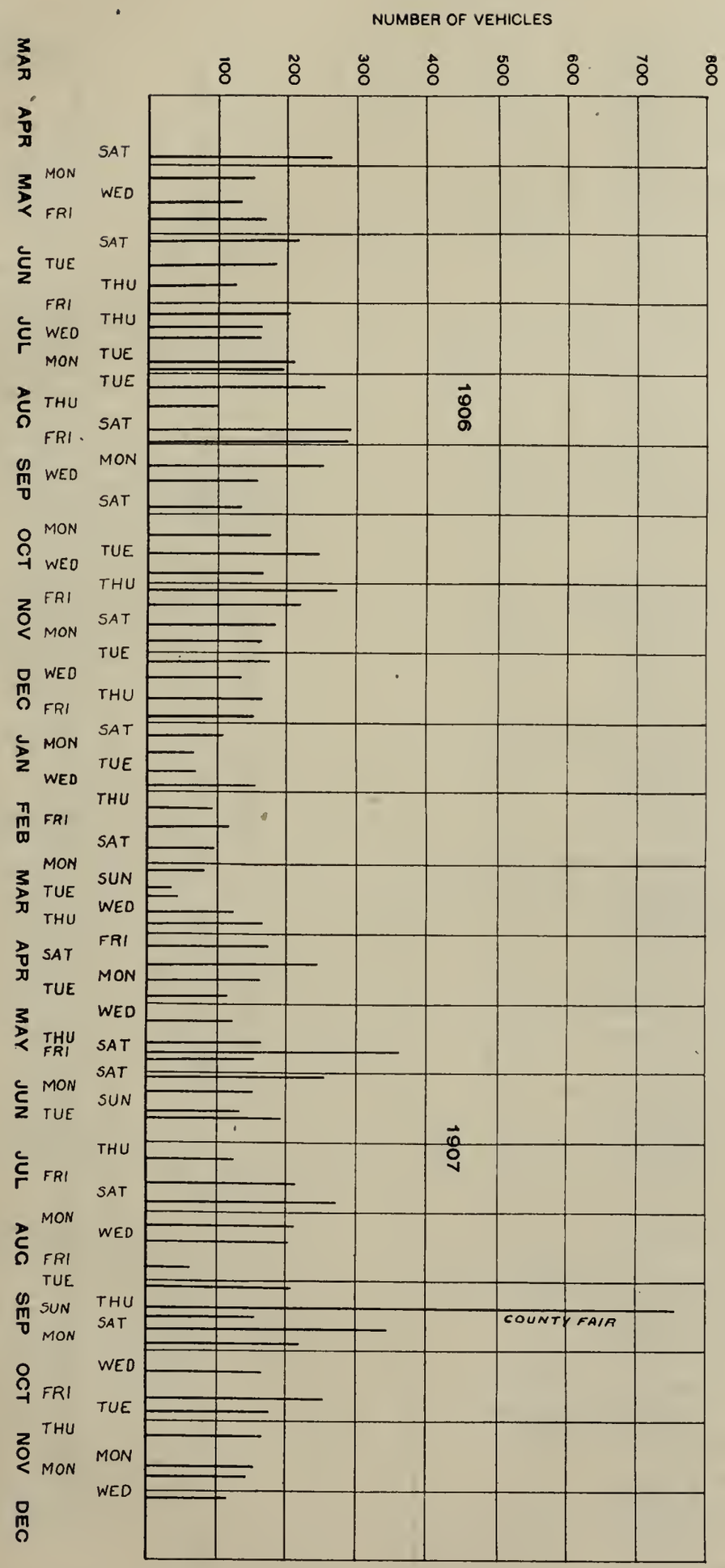
NUMBER OF VEHICLES
100
200
300
400
500
600
700
800
1906
1907
COUNTY FAIR
MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
SAT MON WED FRI SAT TUE THU FRI THU WED MON TUE TUE THU SAT FRI MON WED SAT MON TUE WED THU FRI SAT MON TUE WED THU FRI SAT MON TUE WED THU FRI SAT MON SUN TUE WED THU FRI SAT MON TUE WED THU FRI SAT SUN MON TUE WED FRI SUN MON WED FRI TUE THU MON WED

Fig. 6. Record of Traffic at Station No. 16, Mount Carmel, Wabash County.

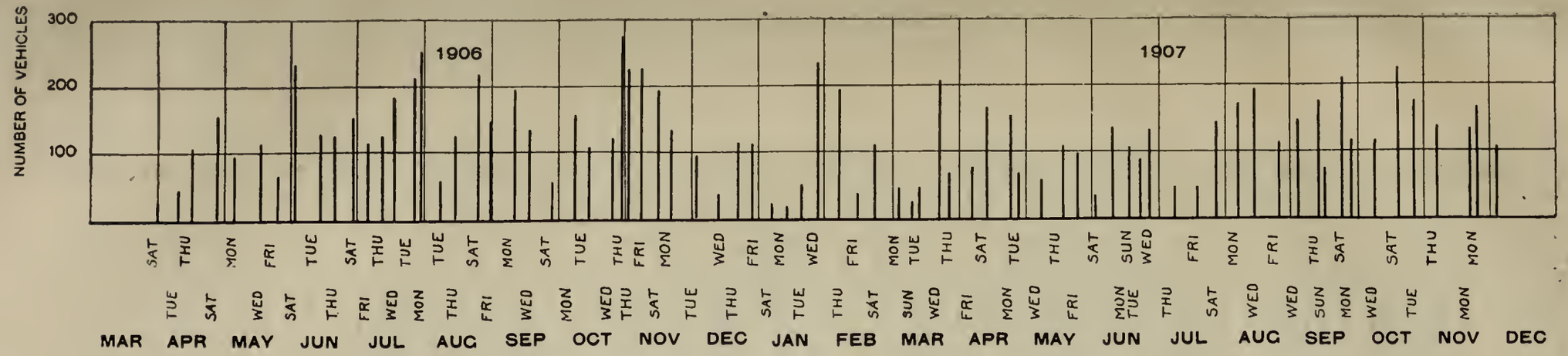


Fig. 7. Record of Traffic at Station No. 5, Elburn, Kane County.

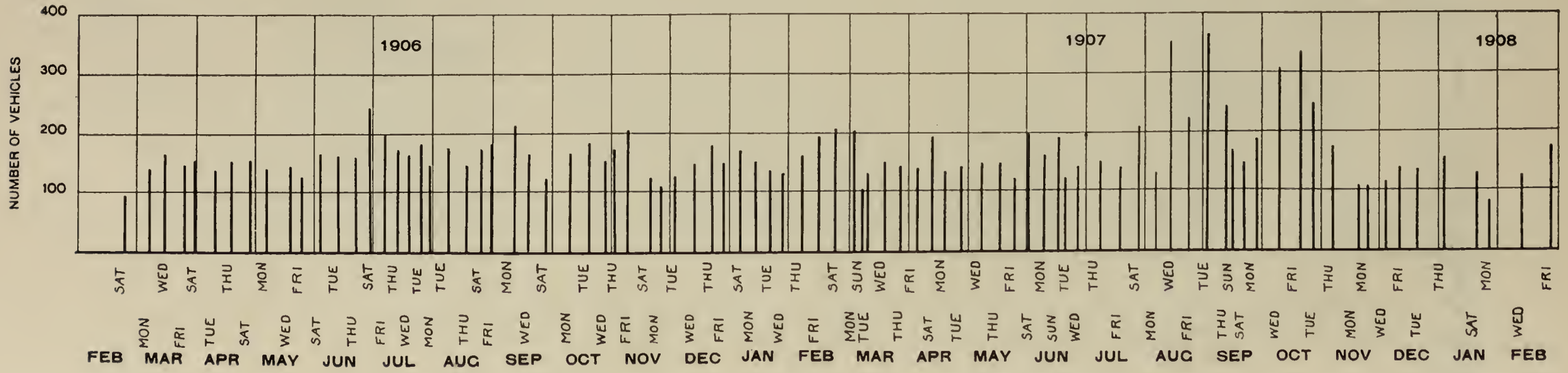


Fig. 8. Record of Traffic at Station No. 13, Jerseyville, Jersey County.

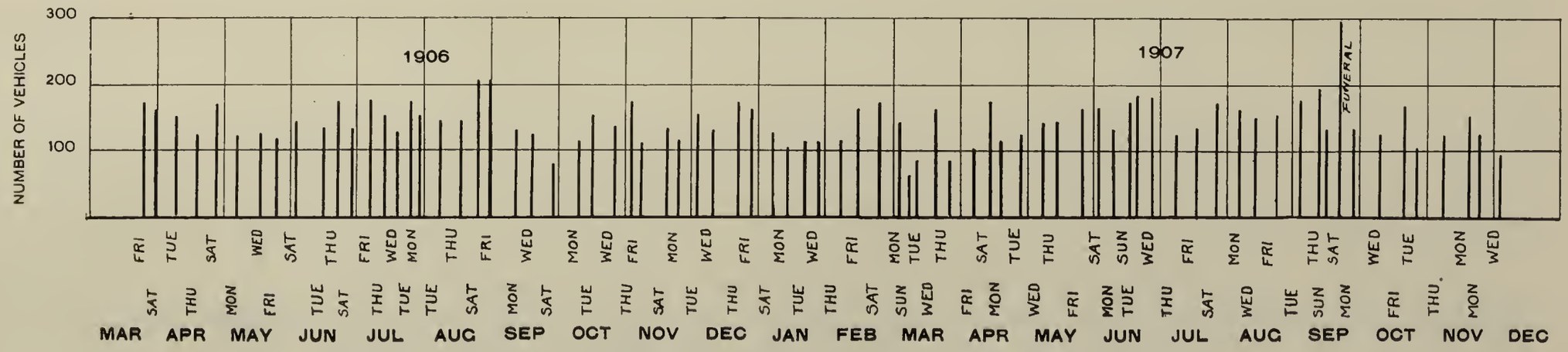


Fig. 9. Record of Traffic at Station No. 8, Peoria, Peoria County.

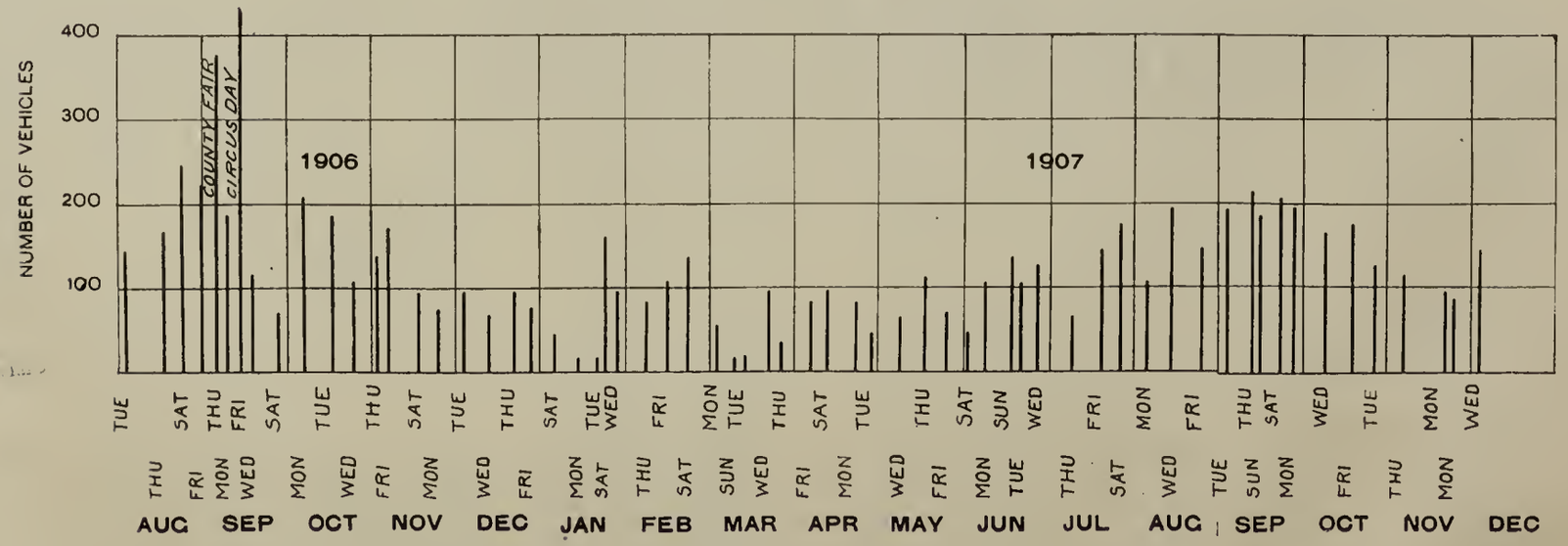


Fig. 10. Record of Traffic at Station No. 29, Champaign, Champaign County.

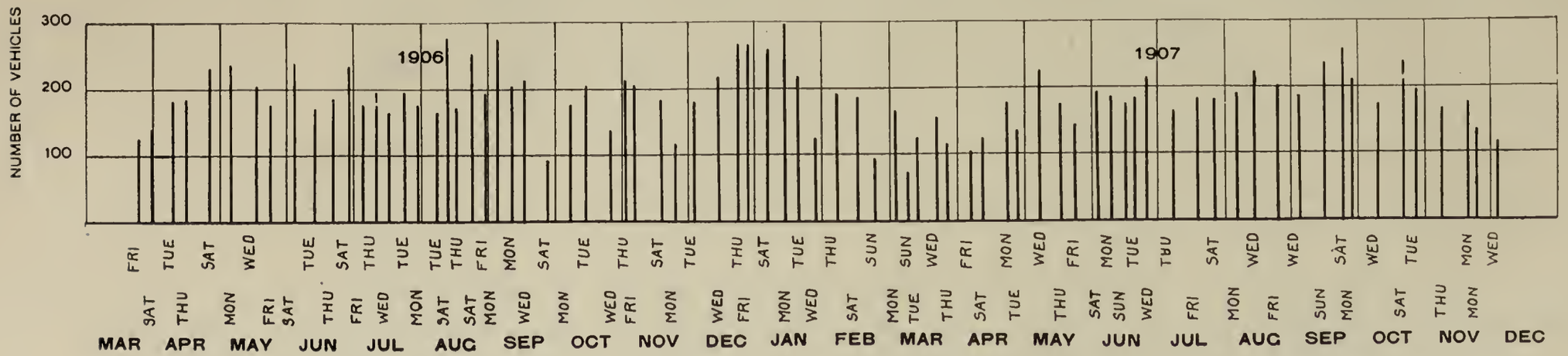


Fig 11. Record of Traffic at Station No. 12, Elgin, Kane County.

road more remote, then the expenditure would be, somewhat in proportion to the amount of traffic. These conclusions should not be construed to mean that it is necessary to spend four or five times as much; although it may not be as profitable to a community to place as expensive construction eight or ten miles out, as on the first mile.

## Table 2.

*Showing Variation in Amount of Traffic at Different Distances from a Given Center.*

| Town. | Road. | Distance miles.. | Average daily traffic..... | Distance miles.. | Average daily traffic..... | Distance miles.. | Average daily traffic..... |
|---|---|---|---|---|---|---|---|
| East St. Louis..... | Falling Springs..... | 1 | 122 | $3\frac{1}{2}$ | 56 | ..... | ..... |
| Elgin ..... | Udina ..... | 1 | 182 | $4\frac{1}{2}$ | 132 | ..... | ..... |
| Jerseyville..... | Fieldon ..... | $1\frac{1}{4}$ | 117 | $3\frac{1}{2}$ | 83 | $8\frac{1}{2}$ | 63 |
| Mt. Vernon ..... | Fairfield ..... | 1 | 156 | $4\frac{1}{2}$ | 132 | ..... | ..... |
| Peoria ..... | Knoxville ..... | 2 | 142 | 4 | 72 | ..... | ..... |
| Rockford..... | Traskbridge ..... | 1 | 568 | $1\frac{1}{4}$ | 123 | ..... | ..... |
| Springfield ..... | Clear Lake..... | 1 | 299 | 4 | 67 | ..... | ..... |
| Springfield ..... | South 6th Street..... | $2\frac{1}{2}$ | 101 | 4 | 60 | ..... | ..... |

These results do, however, point to the absence of so-called through travel, that is, any considerable amount of traffic from one large town to another, and that the present agitation for construction of such roads, as is stated elsewhere in this report, is premature and is not what the present needs demand.

## Traffic Diagrams.

In comparing the diagrams shown in Figures 4 to 11 one is struck in some instances with the great variation in the amount of traffic during the year and in other cases with its comparative uniformity. This may be explained in part by the varying pursuits in the neighborhood of the various roads on which the traffic is shown. It would naturally be expected in a dairy country, where the products must be transported daily, to find a somewhat more uniform distribution of the traffic than in sections where the pursuits were of such a nature that daily use of the roads was not needed.

The diagrams which follow are for stations which show representative conditions. On certain days it will be seen that the traffic was very much less than usual at nearly all stations. These days were usually during very stormy weather prevailing in all sections of the State. At many stations the traffic immediately preceding Christmas is exceptionally large, probably occasioned by the Christmas shopping. Usually the Sunday traffic is found to be much less than that of other days at the same time of the year.

## The Amount of Traffic as the Measure of the Value of a Road.

A traffic census offers a basis from which to compute how much a road is worth to a community and to determine how much per mile can be spent yearly in the construction and maintenance of roads.

Many statistics on this subject have been presented from various standpoints, computing in some instances the tonnage that is hauled over the roads; in other cases, taking the land values as a guide to determine the worth of the road to the community.

A traffic census affords another and perhaps more logical basis of computation from the fact that such a computation considers exactly the amount a road is used, which reasonably may be inferred as the measure of its value.

Let us first consider two roads having approximately the same amount of traffic, that is, the same amount of good weather traffic during good road conditions. In one instance it is found that for this amount of traffic a community has expended for the construction of a certain stretch of road perhaps $5,000 or $6,000 a mile and has thereafter not only maintained but extended this character of construction. The second road is supposed to be unimproved .With similar occupations in the vicinity of the two roads, it is not illogical to draw the conclusion that if one community found it profitable to spend $5,000 or $6,000, it would be equally profitable to the second community which makes as much use of its road as the first community.

Another investigation as to how much per mile a community might be able to afford, could be undertaken in the following manner:

It first is necessary to ask the question how much per mile is a given trip worth, that is, if one has an errand that will necessitate a four mile journey to town or eight miles for the round trip, how much would he be willing to pay rather than give up the trip, or how much would he be willing to pay to make this trip over roads in good condition rather than roads in bad condition.

The answer to this question is hard to ascertain but let us estimate that it is worth a cent per mile, it would, therefore, be worth a cent for each vehicle that passes a certain point. If there is an average of 100 vehicles a day, this mile of road would be worth to the community, excluding Sundays, $313 per year or $626 per year for a road averaging 200 vehicles per day.

That a cent per mile is well within what one would be willing to pay is borne out by experience in those sections where toll roads are still maintained, and where the charge per mile is 4 or 6 cents for a two-horse vehicle and it is seldom less than 3 cents a mile.

A reference to Figure 2 will show that there is a large percentage of roads on which the traffic was counted, with an average of over 100 vehicles a day. Inasmuch as $313 a year is at least three times, if not four times, what would be necessary to maintain gravel or macadam roads, the conclusion is evident that with the traffic averaging considerably less than 100 vehicles a day, it would, if the use of the road is worth a cent per mile per vehicle, warrant an outlay sufficient to build what are usually regarded as very expensive roads.

TABLE 3.

*Synopsis of Traffic Census, Showing Total Number of Vehicles Passing on Dates Given—1907.*

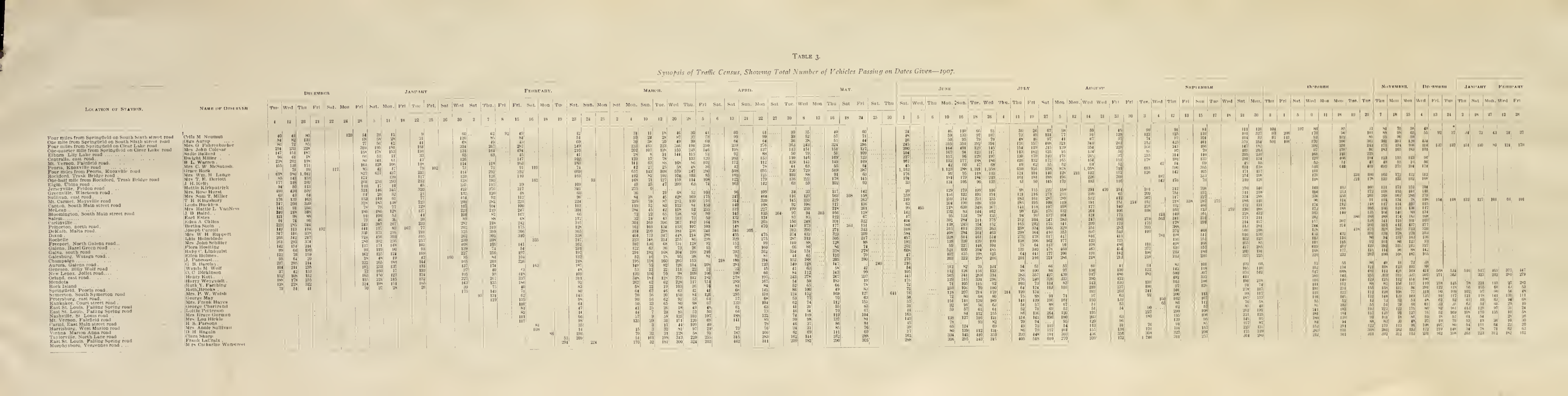

TABLE 3—*Concluded.*

*Synopsis of Traffic Census, Showing Total Number of Vehicles Passing on Dates Given*—1907—Concluded.

| LOCATION OF STATION. | NAME OF OBSERVER. | MARCH. | | | | | | | | APRIL. | | | | MAY. | | | | JUNE. | | | | | | | | JULY | | | AUGUST. | | | | SEPTEMBER. | | | | | | OCTOBER. | | | | NOVEMBER. | | | DECEMBER. | | | JANUARY. | | | FEBRUARY | | MARCH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sat. | Mon. | Sat. | Sun. | Tue. | Mon | Wed. | Thu. | Fri. | Sat. | Mon. | Tue. | Wed. | Thu. | Fri. | Thu. | Sat. | Thu. | Mon | Sun. | Tue. | Wed. | Fri. | Thu. | Fri. | Sat. | Mon. | Mon | Wed | Fri. | Tue. | Wed. | Thu. | Sun. | Sat. | Mon. | Wed. | Mon | Tue. | Tue. | Thu. | Mon | Mon | Wed | Fri. | Tue. | Thu. | Sat. | Mon. | Wed | Fri. | Mon. | Wed. |
| | | 2 | 4 | 9 | 10 | 12 | 11 | 20 | 28 | 5 | 13 | 22 | 30 | 8 | 16 | 24 | 30 | 1 | 6 | 10 | 16 | 18 | 26 | 28 | 11 | 19 | 27 | 5 | 12 | 14 | 23 | 3 | 4 | 12 | 15 | 21 | 30 | 9 | 18 | 19 | 29 | 7 | 18 | 25 | 4 | 13 | 21 | 2 | 18 | 27 | 12 | 28 | 9 | 25 |
| Marshall, National road | Mrs. M. M. Hedrick | 184 | | | 30 | 71 | | 265 | 130 | 193 | 347 | 217 | 134 | 185 | 163 | 216 | | 177 | | 214 | 214 | 208 | 289 | | 172 | 118 | 254 | 153 | | 104 | 176 | 234 | | 215 | 182 | 411 | 274 | 192 | 230 | | 216 | 182 | 193 | 157 | 158 | 92 | 203 | 122 | 252 | 111 | 66 | 81 | | | | |
| Olney, Vincennes road | Mr. Frank Hunt | 128 | | | 23 | 35 | | 154 | 146 | 116 | 145 | 146 | 74 | 111 | 170 | 161 | | 39 | | 127 | 143 | 137 | 189 | | 114 | 104 | 164 | 149 | | 163 | 91 | 173 | | 124 | 126 | 208 | 178 | 228 | 195 | | 157 | 184 | 140 | 138 | 110 | 82 | 98 | 101 | 98 | 87 | 27 | 11 | | | | |
| Effinghani, National road | Mrs. Mary Jadie | 52 | | | 24 | 55 | | 154 | 94 | 93 | 166 | 193 | 130 | 180 | 237 | 322 | | 160 | | 175 | 121 | 197 | 275 | | 248 | 345 | 395 | 392 | | 423 | 415 | 172 | | 420 | 216 | 195 | 382 | 426 | 324 | | 451 | 428 | 384 | 469 | 435 | 326 | 220 | 208 | 221 | 168 | 197 | 130 | | | | |
| Jerseyville, Fieldon road | Ellie Bond | 29 | | | 24 | 33 | | 128 | 31 | 48 | 104 | 107 | 42 | 53 | 81 | 64 | | 23 | | 80 | 85 | 76 | 118 | | 30 | 43 | 117 | 135 | | 128 | 107 | 90 | | 113 | 61 | 153 | 92 | 88 | | 141 | 142 | 85 | 78 | 130 | 77 | 81 | 92 | 102 | 47 | 106 | 41 | 54 | | | | |
| Champaign, Bloomington road | Mrs. W. A. Gridnley | 86 | | | | 19 | | 55 | 43 | 68 | 125 | 95 | 28 | 40 | 61 | 72 | | 32 | | 84 | 81 | 203 | 131 | | 81 | 86 | 120 | 68 | | 164 | 85 | 156 | | 236 | 102 | 304 | 153 | 135 | 124 | | 110 | 101 | 102 | 91 | 78 | 105 | 170 | 70 | 180 | 171 | 62 | | | | | |
| Champaign, Bloomington road | Mrs W. M. Rayborn | 15 | | 15 | | 3 | | 26 | 8 | 13 | 15 | 24 | 5 | 14 | 23 | 14 | | 5 | | 17 | | 33 | 22 | | 18 | 10 | 25 | 16 | | 31 | 14 | 21 | | 25 | | 11 | 24 | 26 | 29 | | 14 | 56 | 24 | 16 | 18 | 10 | 17 | 17 | 22 | 19 | 8 | 18 | | | | |
| Salem, Salem-Vincennes | Mrs. O. A. Sullivan | 35 | | | 7 | 23 | | 59 | 28 | 42 | 44 | 68 | 28 | 28 | 61 | 46 | | 37 | | 33 | 40 | 39 | 42 | | 29 | 45 | 55 | 51 | | 62 | 23 | 71 | | 69 | 47 | 86 | 59 | 53 | 78 | | 11 | 65 | 31 | 18 | 47 | 32 | 39 | 44 | 33 | 26 | 3 | 6 | | | | |
| Champaign, Bloomington road | Vesta Rayburn | | 17 | | 14 | 8 | | 40 | 14 | 22 | 25 | 35 | 20 | 21 | 23 | 22 | | 16 | | 28 | 34 | 46 | 37 | | 11 | 54 | 60 | 21 | | 50 | 32 | | 45 | 77 | 63 | 69 | 41 | 43 | 52 | | 25 | 26 | 31 | 27 | 40 | 29 | 49 | 20 | 25 | 24 | 23 | | | | |
| Greeneville, Wisetown road | Roy Van Deusen | | | | 23 | | | 215 | 123 | 138 | 167 | 170 | 108 | 121 | 141 | 213 | | 103 | | 139 | 188 | 186 | 131 | | 134 | 141 | 195 | 242 | | 190 | 217 | 179 | | 188 | 269 | 290 | 167 | 161 | 242 | | 215 | 138 | 212 | 160 | 204 | 128 | 110 | 157 | 161 | 163 | 163 | 67 | | | | |
| Decatur, Bloomington road | H. H. Crawford | | | | | | 214 | 287 | 150 | 193 | 351 | 246 | 206 | 208 | 414 | 301 | 862 | 129 | | 107 | 265 | 362 | 475 | | 335 | 222 | 367 | 252 | | 229 | 224 | 335 | | 354 | | 295 | 286 | 224 | 215 | | 207 | 215 | 165 | 242 | 179 | 178 | 186 | 168 | 205 | 184 | 139 | 155 | 158 | 182 | | | |
| Beardstown, Chandlerville road | Mrs. Luther Hammer | | | | | | 85 | 241 | 105 | 122 | 189 | 170 | 71 | 131 | 168 | 102 | | 119 | | 118 | 140 | 111 | 109 | | 100 | 152 | 266 | 191 | | 120 | 311 | | 160 | 173 | 118 | 176 | 178 | 102 | 187 | | 132 | 159 | 146 | 124 | 138 | 102 | 112 | 63 | 201 | 98 | 72 | 88 | 59 | 69 | | | |
| Monmouth, Rock Island road | S. T. Geisler | | | | | | | 189 | 81 | 129 | 198 | 164 | 216 | 231 | 250 | 225 | | 275 | | 171 | 245 | 239 | 174 | | 152 | 167 | 212 | 237 | | 215 | 334 | 375 | | 295 | 197 | 286 | 339 | 342 | 263 | | 218 | 316 | 161 | 153 | 120 | 177 | 230 | 204 | 252 | 175 | 112 | 14 | 154 | 144 | | | |
| Rockford, State road | Mrs. J. L. McLain | | | | | | | 77 | 85 | 35 | 89 | 86 | 73 | 76 | 73 | 47 | 116 | 110 | 125 | 96 | 124 | 56 | 88 | | 68 | 69 | 55 | 45 | 76 | 86 | 65 | 87 | | 94 | 151 | 123 | 75 | 69 | 111 | | 65 | 82 | 86 | 67 | 58 | 68 | 89 | 52 | 102 | 55 | 52 | 71 | 106 | 96 | | | |
| Rockford, Trask Bridge road | J. F. Searles | | | | | | | 199 | 184 | 180 | 338 | 278 | 231 | 242 | 203 | 161 | | 282 | | 259 | 289 | 170 | 310 | | 304 | 322 | 341 | 301 | | 306 | 372 | 384 | | 343 | 265 | 283 | 451 | 356 | 389 | | 317 | 418 | 371 | 447 | 315 | 356 | 398 | 110 | 126 | 201 | 271 | 398 | 373 | 414 | | | |
| Rockford | Mrs. Lida Stockburger | | | | | | | 156 | 112 | 111 | 118 | 178 | 137 | 157 | 143 | 101 | | 188 | | 118 | 259 | 296 | 376 | | 258 | 353 | 350 | 252 | | 360 | 262 | 191 | | 257 | 277 | 399 | 238 | 233 | 235 | | 178 | 178 | 161 | 163 | 128 | 167 | 315 | 137 | 167 | 152 | 102 | 123 | 184 | 168 | | | |
| Lincoln, Fair Ground road | Margaret Gluick | | | | | | | | 53 | 61 | 97 | 70 | 73 | 55 | 46 | 49 | | 25 | | 65 | 93 | 67 | 50 | | 67 | 54 | 73 | 64 | | 69 | 74 | | 95 | 80 | 111 | 93 | 78 | 71 | 93 | | 106 | 85 | 99 | 107 | 158 | 151 | 90 | 99 | 134 | 101 | 103 | 109 | 117 | 111 | | | |
| Joliet, Manhattan road | Mrs. J. A. Patterson | | | | | | | | 102 | | 204 | 127 | 98 | 111 | 89 | 90 | | 174 | | 96 | 201 | 132 | 138 | | 123 | 155 | 182 | 121 | | 151 | 124 | 114 | | 180 | 222 | 285 | 169 | 147 | 137 | | 129 | 113 | 110 | 114 | 103 | 95 | 171 | 244 | 157 | 89 | 102 | 101 | 99 | 122 | | | |
| Streator, East Main road | Mrs. W. H. Rowe | | | | | | | | 85 | 94 | 220 | 144 | 90 | 148 | 175 | 126 | | 257 | | 227 | 177 | 202 | 198 | 311 | 181 | 186 | 282 | 266 | | 278 | 294 | | 328 | 245 | 158 | 225 | 218 | 317 | | 371 | 295 | 234 | 226 | 206 | 247 | 194 | 202 | 191 | 167 | 220 | 147 | 287 | 154 | 276 | | | |
| Pontiac, East Howard road | Mabel Grandy | | | | | | | | 90 | 114 | 218 | 135 | 101 | 110 | 169 | 94 | | 126 | | 105 | 186 | 118 | 155 | | 134 | 145 | 233 | 158 | | 191 | 179 | | | 182 | 170 | 296 | 184 | 198 | 157 | | 169 | 118 | 143 | 91 | 122 | 152 | 240 | 122 | 254 | 206 | 110 | 146 | 81 | 159 | | | |
| Elgin, Udina road | Mrs. Julia McCormick | | | | | | | | 85 | 72 | 73 | 88 | 86 | 98 | 93 | 74 | | 125 | | 123 | 145 | 131 | 182 | | 126 | 118 | 147 | 131 | | 208 | 150 | | 130 | 217 | 209 | 251 | 197 | 165 | | 240 | 124 | 115 | 161 | 123 | 110 | 165 | 108 | 110 | 66 | 60 | 111 | 97 | 170 | | | |
| Delavan, Peoria road | Mrs. Emma Burlingame | | | | | | | | 51 | 46 | 96 | 111 | 48 | 75 | 95 | 127 | | 53 | | 65 | | 83 | 80 | | 73 | 64 | 166 | 136 | | 142 | 93 | 121 | | 126 | | 156 | 101 | 127 | 119 | | 82 | 80 | 83 | 106 | 78 | 122 | 72 | 31 | 111 | 129 | 30 | 89 | 52 | 78 | | | |

This analysis as to the worth of a road to a community takes into account the use of the road not only for the purposes of hauling, but for social purposes as well, and, therefore, measures more nearly the value of the road than any method which considers only the commercial view point.

The description of this work and some of the results given in this chapter are sufficient to show the instructive nature of the data that have been collected. The data in full, however, would require the publication of a large number of tables which would not appeal to the average reader, and it has been thought better to present them in a separate bulletin at some future time.

# Earth Roads.

## The Road Drag.

In the first annual report, 1906, in the chapter on earth roads, is a discussion of the methods of constructing and maintaining earth roads, dwelling particularly on the use of the road drag.

The use of the drag has been encouraged at all Farmers' Institutes and other meetings. In addition, 100,000 bulletins showing how a drag should be made and used have been distributed. As a result, hundreds of road drags are to be found in counties where such a thing was almost unknown two years ago. In some townships that have been inspected over 80 per cent of the roads have been dragged.

In McLean county in 1906 it was estimated that there were 152 drags in use. According to a recent investigation by the Bloomington Pantagraph, in its issue of December 6, 1907, two-thirds of the county was reported as having 364 drags, or an estimate for the whole county of over 500.

The total number of drags in the State, as estimated in 1906, was 4,000. If the increase in their use has been proportionate to that in McLean county, the total numeber at present would be over 13,000.

From the fact that there were a larger number of drags in use in McLean county in 1906 than in many other counties where the interest in this work has been taken up since that time, and has gone ahead proportionately more rapid, it is probable that there are not less than fifteen thousand road drags in the State.

Evidence of their use is to be seen on all sides and their effect is nearly everywhere reported to be beneficial. Too much, however, should not be expected from this work. It will not convert a sticky gumbo road into a road surface that will not pick up when the moisture in the surface of the road is just the right amount to make the soil sticky. It will, however, keep such a road in good condition much longer in the fall and, if dragged when possible during the winter, will be very much better in the spring.

Farmers are seen coming into town on road drags, often bringing their children to school in this way; some have the drags tied on behind their wagons. There is only one drawback to be foreseen in this widespread interest in the use of the road drag, and that is, that it may relax, as it is largely done voluntarily by farmers living along the roads.

What will probably operate to keep this beneficial work going ahead will be the effect of the road drag law passed in 1907. Seventy-five thousand copies of this law, together with information on the use of the road drag, have been printed by the Highway Commission, so it is pretty thoroughly known.

This law provides that the highway commissioners may contract with the tenants or land owners adjoining the road, they to be given the preference, to have the dragging done during December, January, February and March at a rate of not to exceed $1.00 a mile for two round trips, dragging for a width of twenty feet, and 75 cents for the same work in the summer time. The law does not, however, compel the commissioners to make contracts, nor can those who drag the road voluntarily, unless a contract has been made with them, force the commissioners to pay for such work.

### Road Drag Law.

An Act *authorizing the commissioners of highways in any township in counties under township organization, and the commissioners of highways or boards of county commissioners in counties not under township organization, to maintain earth roads with a drag and to contract for the use of the same and to provide penalty for injury to work so done.*

Section 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly:* That the commissioners of highways in any township in counties under township organization, or the commissioners of highways or boards of county commissioners in counties not under township organization, are hereby authorized to have earth roads dragged at all seasons of the year whenever they may deem it beneficial to have such work done; and they may contract, a preference to be given adjoining land owners or tenants, to have a given piece of road dragged at a rate not to exceed one dollar ($1.00) per mile for each time dragged, if such work is done during the months of December, January, February or March, and not to exceed a rate of seventy-five cents (75) per mile for each time dragged, if such work is done during other months of the year than aforesaid: *Provided*, that the width required by the highway commissioners to be dragged shall not be less than twenty (20) feet, if the width of the roadway will permit: *Provided, also*, that the dragging is done as nearly as practicable in accordance with the instructions of the highway commissioners of the township.

Sec. 2. It shall be unlawful for any person or persons to place loose earth, weeds, sods or other vegetable matter on the portion of a road which has been dragged and so maintained in good condition, or to place any material in such a manner as to interfere with the free flow of water from the dragged portion of the road to the side gutters or ditches: *Provided*, that this restriction shall not apply to deposits of earth or other material that may be made by the authority of the proper road officials, if necessary, for filling or raising the elevation of a given section of road or other necessary construction work.

Sec. 3. It shall also be unlawful for any person or persons to drive or cause to be driven a vehicle of any description in or upon any portion of the highway immediately after the same has been dragged and before such portion of the highway shall have partially dried out or frozen: *Provided*, that nothing in this section shall apply in those instances where it is impossible to drive with safety at one side of said dragged portion of the road, or where a vehicle does not make a rut on such dragged portion of the road, injurious to the work accomplished by the use of the road drag, or where a vehicle does not make a rut nearer than nine (9) feet from the center of the dragged portion of the road.

Sec. 4. Any person violating any of the provisions of this Act shall be considered guilty of a misdemeanor and shall on conviction before any justice of the peace be fined a sum not less than one dollar ($1.00) nor more than five dollars ($5.00) for the first offense, and for such offense thereafter a sum not less than five dollars ($5.00) and not exceeding ten dollars ($10.00), said fund to be paid into the road funds of the township or road district where the damage may have been sustained.

Sec. 5. All Acts or parts of Acts which are inconsistent herewith are hereby repealed.

Approved May 1, 1907.

There has been considerable difference in the attitude of the various commissioners towards this work; some have gone ahead with it and have had many miles of their roads dragged; others have not taken up the work, some times through lack of funds and some times through lack of interest.

In nearly every instance it is reported that there is little use in dragging the road, if it has not been properly shaped and graded.

It is thought that the following account written by Mr. F. W. Nottingham of Pleasant Plains, Illinois, will be interesting as it describes very clearly his experience under various conditions. What Mr. Nottingham describes as "dry" dragging should not be understood to mean that he drags the road when the surface is dry in the sense that it is dusty. "Dry" dragging in this instance would perhaps better be called moist dragging as there must be enough moisture in the soil to insure that it packs solidly. Many have expressed the opinion that about the only time some sticky soils can be successfully dragged is while it is actually raining.

### Experience With the Road Drag.

(By S. W. Nottingham, Pleasant Plains, Ill.)

The following are some of the principal points that have come up in my experience in the use of a road drag. The road drag has a place to fill. What we want is the best result with the least labor; so the first thing to do is to make a drag, one that will do the best work with the least horse power.

Seven feet is a very nice length for a drag, two planks 2½ inches thick by 10 or 12 inches wide, two cross pieces three feet long (most any width will do from 4 to 12 inches). We will make a left-hand drag (a right hand drag is preferred by many as it is considered more convenient to turn it at the ends of the road) that will run on the right hand side of the road and move the dirt to the left.

Set the planks on edge two feet apart, move the back plank one foot to the left, lay your cross pieces on the upper edge of the planks one foot from the end of the boards with same angle that the boards have, (so that when the right end of the drag is pulled ahead the end of the back boards will follow the end of the front one instead of extending out farther as it would do if it were made square. Mark where the cross pieces are and saw in one inch on the front side and down to two inches on the back side of each plank. This will let the boards lean 5 or 6 inches forward, bore a hole through the cross pieces and down through the plank at all four points and put in ½" bolts. Put a block under each of the cross pieces just behind the front board, put a half inch bolt up through this. One can take straps of iron and have hooks made, with the hooks up, with two holes in them so as to fit the bolts that are through the front board and those through the blocks. These hooks on top of the drag are to pull by, so they will not be in the way of the dirt. Put a shoe all the way across the front board. Now have your right hand chain about 18 inches long, the left hand 27 to 30 inches long or any length to suit the case. Stand on the back of drag. This drag is suited

A. The Road Drag at work. Note the angle it makes with the road so that a small amount of material is pushed to the center of the road.

B. Delavan Township, Tazewell County. Locust street. earth street maintained with drag. View taken March 21, 1908. Compare the condition of this street with the average earth street at this time of the year.

for three horses; from 6 to 10 miles is a good half day's work for a team. The conditions of the roads and the kind of weather have much to do with the distance one can go. Three horses can do as much with this leaning drag as four can with one that stands straight up.

There are two times to drag roads, wet and dry dragging. Wet is when it is muddy and the muddier the better. Dragging dry is when the road has dried enough so the dirt will not stick. In the summer, there is only about one-half day after each rain when the road is really fit to drag at all. One can use four horses on this drag but when it is muddy the horses track up more road than the drag takes. When the road is firm it is all right. Have seen the drag weighted and four horses used. When it began to harden, the man used as a weight a box almost as long as the drag and six small rocks. He said they were the handiest things yet. He could move the rocks around and make the drag even, as he wanted it.

Our best roads are where we have good ditches on the sides, some three feet deep or more. The road should be rounding enough to run the water off when the holes are kept filled with the drag.

You can not do a road any permanent good with a road that is lower in the middle than it is on the sides. The road must first be put in shape, then you can keep it in shape with a drag. Most of my dragging has been done when the earth was so dry it did not stick. I have had good results on one hill that was worked late in the fall. It was kept dragged in the late winter and early spring, and was a good road when in other years it was bad. That was a year ago. This spring we have had bad roads, and the conditions were such that you could not improve them much with a drag, for there are times when the amount of moisture in the soil is such that it makes dragging practically impossible. Most of our people think that dragging wet does no good and some times they say it does harm but dragging wet is a good thing, for it makes the ground hard when it dries and that is the way we want the roads to be.

I have three kinds of drags, and the best one to use depends on the condition of the roads. In going over four miles of road the other day I found three conditions, first, where it worked nicely, then came mud that was too sticky and was not dry enough to drag dry, then came the black soil with good ditches and tiling. Here the dirt was so soft I had to walk to keep it from rolling up in front of the drag.

Many of the people in this neighborhood think the drag is a great thing, but most of our roads need to be graded up before we can get the best results from dragging.

## Results at Delavan.

A good illustration of what can be accomplished by persistent effort with a road drag is to be found at Delavan in Tazewell county. The streets of Delavan are unpaved and have always been extremely muddy and at times almost impassable until a road drag was tried. Mr. J. W. Williams, superintendent of streets, undertook to keep the streets dragged. At times he was about to give up but finally continued and the result is shown in Plate 5, Fig. B. This view was taken March 21, 1908, at a time when the earth streets in most towns are rough, full of ruts, hold water and mud and present a generally unsightly, uninviting appearance. Attention is called to the report of the Galva Good Roads Association found herein for further account of results of modern methods of maintaining earth roads. The results can be had if energy and pains are put into the work.

## Experimental Earth Roads.

The most important problem to solve in road building in Illinois, is the possible utilization of the heavy soils in such a manner as will produce a road which will be able to sustain traffic satisfactorily the year around. Until more failures are encountered and fewer methods left untried, it is believed that this problem is not insurmountable.

As a beginning on this work, there was constructed a stretch of earth road in a manner somewhat different than is usually employed. It was the intention when this work was undertaken to experiment with a mixture of tars and oils with the earth to the end that some waterproof coating might be formed in a comparatively inexpensive manner that would be durable under ordinary conditions of traffic.

This part of the work it was impossible to carry out from the fact that the season was so rainy during the summer of 1907 that at no time were the roads sufficiently dry to attempt the application of either tar or oil. This work will, however, be carried on during 1908, if the weather conditions are favorable.

The following is an account of the earth road experiments as far as undertaken. It is believed that this work is well worth doing, and that it is the best method of preparing the earth roads for maintenance with a road drag. Similar experiments on other soils will be undertaken during the coming season.

During 1907 a stretch of road near Springfield, Sangamon county was selected and construction undertaken in the following manner: The road roller was provided with very blunt-ended spikes or spuds set in the rear wheels of the roller in the place in which the usual spikes are fastened. These spikes or spuds were circular and 4 inches wide at the end and 6 six inches broad at the base. They are tapered in this manner so that as the roller moves over the road they will not tear up the edges of the holes they make. On a 10 ton roller it is estimated that the pressure of these spuds upon the road surface is about 500 pounds per square inch. As the road became hard, the entire weight of a single driver was borne up by one of the spuds, thus producing this large pressure. On some sections the road was first plowed. The material was drawn to one side of the road which was then graded and rolled with the spuds in the wheel until the roadbed was firmly compacted. The earth was thrown back on the road in layers, and rolling continued until the compacted layer was about 18 or 20 inches in thickness, extending for about 16 feet. Owing to the very wet weather, the work on the Springfield section was not completed before it was necessary to start a similar piece of work at Bement, Piatt county, where the road commissioners were very anxious that the work should be done, and arrangements had been made to do the work at a certain time. At Bement about 1¾ miles of road were constructed. The method of construction on the different sections was somewhat varied. One was made by cutting out the center portion of the road until a broad trench 8 or 10 inches deep was formed for a width of 12 to 15 feet. The bottom of this trench was then rolled as already described. The surface, after the roller had

gone over the road, had very much the appearance of a huge waffle as the spuds had filled it full of holes. The rolling was continued in this manner until the spuds penetrated scarcely one half inch. The earth that was dug from the trench was replaced and the rolling continued until the center of the road was firm and compact.

Another section of the road was made in practically the same manner with the exception of cutting out the trench as this was not believed to be essential. The surface was well rolled and the material worked in from the sides and spread with the road grader, rolling continuing in the meantime. Special care was taken of the drainage and the ditches were shaped with very sloping sides to prevent their caving in. (See plate 3, figures A and B.)

On another section the spuds were removed from the wheels and the earth was rolled with the smooth wheels. This is not believed to give as good results as where the earth is tamped in with the spuds as just described.

The idea of this method of construction was based on the theory that a thick layer of well compacted clay or impervious earth will, if given the proper oval shape, shed water and not become as muddy or cut through as readily as is ordinarily the case.

Since the report of Mr. Burgess was made, the road was inspected, March 9, 1908, and the surface found to be very much cut up. The road did not, however, contain as much water, nor was it cut nearly as deep as the roads which had not been graded and rolled.

An examination of the road-bed showed there was perhaps an average of four or five inches of mud, below which the road-bed was solid and contained but little moisture. The character of the soil, however, which is an extremely sticky "gumbo," rendered the road practically as difficult to travel during the wettest period as other roads. Indeed, it was found at times that owing to the fact that the road surface of the experimental road was somewhat drier, it was actually more inconvenient for traffic than roads which were much wetter. This is explained by the fact that this soil is such that when it contains a certain amount of moisture, it adheres to the wheels and practically prohibits travel; if it is either wetter or drier than this particular condition, the mud does not adhere to the wheels.

The surface of this road remained intact and offered no impedient to traffic until the first frost appeared. It was then observed that the road peeled up in cakes, clinging to the wheels and made extremely bad going. A number of attempts have been made during the winter to drag the road, but at no time has there been sufficient moisture on the road to drag it properly. There is little doubt but that this road will dry out and become good considerably earlier than adjoining roads.

The question to be decided is, whether or not the road by this treatment was enough better on the whole to pay for this work that was done at a cost of $250 to $300 a mile. It is the opinion of a number of the residents and those who have used the road that this is the case.

Where repeated, it will probably be a very great advantage not to work the road for as great a width and leave, if possible, the grass or

sod undisturbed at least at one side of the road, which will afford, where the soil is stickiest, a place where vehicles can travel more conveniently than upon the sticky road surface, proper. There is little question that roads of this character would be vastly improved if it were possible to cover them with sand which would become incorporated with the soil. This method, it is understood, has been tried to some extent in portions of Mason county and proved successful.

There is, however, difficulty in many places where there is gumbo soil to obtain sand at a cost that would justify this treatment.

It will be the endeavor to make similar experiments in earth road construction on other varieties of soil. Experience has shown that on many well traveled roads dragging is only partially successful where the traffic is so great as to cut up the road before it has time to harden, but if this road could be put in good, hard, smooth shape to begin with, it could be maintained in very much better condition with the drag than otherwise.

# Tests of Road Materials.

## Samples Collected in 1907.

With the coöperation of the State Geological Survey, it has been possible to make a careful preliminary investigation of road making materials in certain parts of the State. The availability and extent of the deposit were ascertained in each case and a number of samples of material was secured of which careful tests were made at the office of public roads at Washington.

The result of these tests are given in the adjoining table. These results are in addition to those given in a similar table on page 73 of 1906 report in which is a general description of the tests, which it is not necessary to repeat.

An examination of the results will show that with but one or two exceptions, the limestones run remarkably uniform, and in general have a rather low wearing resistance. The hardest limestones will have a wearing resistance, or co-efficient of wear as it is called in the table, of 10 to 13; occasionally, specimens are found with a higher co-efficient. Reference to the table shows none over 11.

It will be necessary to take special precautions in the use of these softer limestones, such as are obtainable in Illinois for road building. As is pointed out elsewhere, it is not advisable to build roads out of these limestones and place less than the three inch size material in the top course, using the second size or one and one-half inch material in the lower course of the road. This has the effect of greatly increasing the wearing qualities of the road, particularly when it is necessary to use the softer grades of material.

## Table 4.

### *Physical Tests on Road Materials.*

| County. | Locality. | Name of Material. | Specific gravity..... | Weight per cubic foot in pounds ..... | Pounds water absorbed per cubic ft. | Co-Eff. of wear ..... | Cementing value .... |
|---|---|---|---|---|---|---|---|
| Adams ..... | Quincy ..... | Chert and Limestone.. | 2.70 | 168 | 0.51 | 7.6 | Good .... |
| Adams ..... | Quincy ..... | Limestone (Marble) ... | 2.70 | 168 | 1.01 | 6.6 | ..do..... |
| Clark..... | Casey ..... | Limestone ..... | 2.70 | 168 | 0.68 | 7.7 | ..do..... |
| Clark.... ..... | Marshall ..... | ..do..... | 2.65 | 165 | 0.91 | 10.8 | ..do..... |
| Cook ..... | Chicago ..... | Slag ..... | 2.85 | 178 | 0.33 | 3.0 | ..do..... |
| Edgar..... | Paris..... | Limestone ..... | 2.65 | 165 | 0.88 | 7.5 | ..do..... |
| Edgar..... | Paris..... | ..do..... | 2.70 | 168 | 1.02 | 7.4 | ..do..... |
| Edgar..... | Cherry Point . | ..do..... | 2.70 | 168 | 0.69 | 6.0 | ..do. .... |
| Hancock ..... | Hamilton ..... | ..do..... | 2.55 | 159 | 3.71 | 6.2 | ..do..... |
| Hancock ..... | Pontoosuc .... | Argilaceous Limestone | 2.55 | 159 | 4.89 | 5.0 | ..do..... |
| *Hancock ..... | Wilcox Tp .... | Limestone ..... | 2.68 | 168 | 0.60 | 11.0 | ..do..... |
| Henderson .... | Gladstone..... | ..do..... | 2.60 | 162 | 1.36 | 4.4 | ..do..... |
| Peoria ..... | Maxwell ..... | ..do..... | 2,60 | 162 | 1.71 | 7.6 | ..do..... |
| Peoria . ..... | Maxwell ..... | ..do..... | 2.65 | 165 | 1.48 | 8.0 | ..do..... |
| Peoria ..... | Princeville.... | ..do..... | 2.65 | 165 | 1.73 | 10.1 | Fair..... |
| *Randolph .... | Menard ..... | ..do..... | 2.59 | 162 | 2.45 | 9.4 | Good .... |
| Rock Island... | Port Byron ... | Dolomite ..... | 2.80 | 175 | 0.83 | 6.9 | ..do..... |
| Rock Island... | Moline ..... | Limestone ..... | 2.65 | 165 | 0.99 | 8.0 | ..do..... |
| Vermilion..... | Fairmount .... | ..do..... | 2.65 | 165 | 1.20 | 7.9 | ..do..... |

*These tests were made at the University of Illinois Road Material Laboratory. The remaining tests were made at the Road Material Laboratory of the Office of Public Roads at Washington, D. C.

## Crushed Stone Prepared at the Penitentiaries.

### Convict Labor on Road Material, Etc.

AN ACT *to amend section 2 of an Act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State, and for preparing road building and ballasting material, upon the requisition of the State Highway Commission," approved May 18, 1905, in force July 1, 1905.*

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly:* That section 2 of an Act entitled, "An Act authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State of Illinois in the manufacture of tile and culvert pipe for road drainage purposes, and in the manufacture of machinery, tools and appliances for the building, maintaining and repairing of the wagon roads of the State; and for preparing road building and ballasting material upon the requisition of the State Highway Commission," approved May 18, 1905, in force July 1, 1905, be, and the same is hereby amended so as to read as follows:

§ 2. The commissioners of highways in any township in counties under township organization or the commissioners of highways or boards of county commissioners in counties not under township organization, may make application to the said State Highway Commission for such road building material, tile, culvert pipe, road making machinery, tools and other appliances as may be needed or required by them for the construction, improvement or repairing of the wagon roads in their respective townships or road districts, and where by agreement of the commissioners of highways in counties under township organization, or the commissioners of highways or boards of county commissioners in counties not under township organization, as the case may be, with the city council of any city, or the board of trustees of any village within the limits of such town, any gravel, rock, macadam or other hard road is extended within or through the corporate limits of such city or village then for the construction, improvement or repairing of so much of said road as lies within the corporate limits of such city or village, provided such extension within such city or village shall be of the same cost and kind of material as the road outside such city or village, obligating themselves to use such material according to the rules and regulations formulated and approved by the State Highway Commission.

APPROVED June 3, 1907.

### Revised Law Concerning the Use of Free Macadam.

The law which provides for the distribution of crushed stone, prepared at the penitentiaries has been amended so that this material may be used inside the corporate limits of villages and cities, provided it is

used in extending a road from the township into the corporation, and that the township officials give their consent for the material to be so used.

## Convict Labor.

The employment of convict labor in preparing crushed stone has so far proved satisfactory.

Many inquiries have been received from other states in regard to the details of this plan, which it is believed is one of the most practical ways of employing convict labor in road construction. In a number of states, more particularly in some southern states it has been the practice to work the convicts on the road itself, and especially in North Carolina and Georgia a number of miles of road have been built very successfully in this way.

There is, however, in most sections of the country a natural prejudice against exposing convicts on the public roads. It does not seem justifiable to place the opportunity for escape so alluringly before the prisoner and to impose as a penalty on his very natural desire to seize this opportunity the risk of being shot by armed guards stationed at a considerable distance, as a protection against a sudden rush upon them. If a sufficient number of guards were provided to render the use of rifles unnecessary, it would be found that the cost of paying the guards would more than compensate for the reduced cost of the convict labor, so that in the end the work would probably cost more than if performed with free labor.

Another, and perhaps more important, consideration would be the very natural feeling that the laboring man would have against competing with convict labor which, moreover, would bring this class of work into more or less disrepute.

But the employment of the convicts inside the penitentiaries or within stockades, where they are not exposed to public view, and where the methods of guarding and other precautions taken against escape are practically the same as would be necessary whether the prisoners were idle or employed, seems both humane and practical. Under these conditions, there is no additional cost to the taxpayers at large for the product of their labor, so that whatever is produced by their industry is so much gained by the community. Moreover, preparing the crushed stone interferes, in this State, with no existing industry as the crushed stone is, in almost every instance, used in places where it would not be tried unless it could be secured at the specially low rates that this method of production secures. In fact, it can truly be said that the State, rather than interfering with an existing industry, is in reality creating an industry, for the total amount of crushed stone, even if all the convicts were employed, would at the most be very small when compared to that which would be necessary should any general scheme of road improvement be undertaken, even in but a few localities.

Neither is free labor in any wise brought into unfair competition; on the contrary, work for free labor is created in constructing the roads, which, in many instances, would not otherwise be undertaken.

There is also another point of view which recommends this method of coöperation from the fact that no locality is at any increased expense for the benefits that certain communities, which secured the crushed stone prepared in this way, may derive; nor would the expense to any community be less if no one receive the crushed rock, so that it is difficult to see how a more equitable plan of coöperation could be devised.

In response to an inquiry as to the success of this plan from the standpoint of the prison officials, the following letters were received from General James B. Smith, Warden at the Southern Illinois Penitentiary at Menard and Hon. E. J. Murphy, warden at the Joliet Penitentiary.

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### Report From Southern Illinois Penitentiary.

(By J. B. Smith, Warden.)

The stone department of the Southern Illinois Penitentiary since July 1, 1904, has given employment to 250 or 350 prisoners. Crusher No. 1 located inside the prison walls is a No. 6½ Gates crusher with a capacity of 350 yards per day. This crusher has a bin capacity of 150 yards and also has an elevated track 175 feet in length which gives a storage capacity of at least 5,000 yards, and the crusher is provided with inclines approaching from the north side and the south side and a steam hoist. From this crusher runs an elevated track to the building where the limestone meal or dust mill is located. This dust mill is a Williams mill with a capacity of ten tons per hour. The mill has all up-to-date machinery, having a 150 horse power Springfield boiler and an Ideal engine. The construction of the mill was begun in June and completed in August, 1907.

The cars at the crusher are drawn from either side of the crusher by a steam hoist to the crusher hopper where they are dumped through a trap. The crushed stone is then carried over a screen and passes into the bins.

Work was begun during the month of July, 1906, on the construction of crusher building and bins for a No. 7-½ Gates crusher which is known as crusher No. 2. This building is located eighty rods north-west of the prison yards. This necessitated the State putting in its own track of 120 rods in order that the Iron Mountain and other railroads might have access to same. This plant is furnished with concrete storage bins for the various sizes of crushed stone and screenings, which have a capacity of 4,000 or 5,000 yards.

The top layer of the stone in the quarry from 15 to 20 feet in depth is of blue limestone which is very hard and flinty, and for a depth of 50 feet from the layer of blue limestone is a gray limestone of most excellent quality.

The quarry work is all outdoor work and is the most healthful of all work at the prison, except the farm work. Good health breeds cheerfulness and good humor and these have a marked effect upon the discipline and I have no hesitancy in saying no better employment can be had for our prisoners than the work of the stone department. The work in the stone department has never been as remunerative as in some of the other prison departments, that is, the earnings per man per day has not been as high, but taking into consideration the fact that such a large part of the product of this department is shipped free to various parts of the State for road purposes, it is perhaps after all the most profitable work being done by the prison.

From January 1, 1905, to November 1, 1907, we have shipped 136,920 cubic yards of macadam, rip rap and screenings, about 75 per cent being shipped free for road purposes, and 1,848 tons of limestone dust, a fertilizer which removes the acidity from the soil and sweetens same, has been shipped to various parts of the State, mostly during the last year. There has also been $8,271.01 in building stone shipped.

### Report From Illinois State Penitentiary.

(By Hon. E. J. Murphy, Warden.)

In reply to your communication of the 12th instant, I would say, that the stone crusher connected with this institution has been in operation a little over one year. As the work is conducted here it is altogether satisfactory. We employ about one hundred and fifty men in the quarry connected with the prison, and ship the crushed stone to the road districts of the State, f. o. b. cars. It costs the State about thirty cents per cubic yard to produce this stone. Owing to the fact that the quarry is upon our own ground and adjacent to the enclosure, we have as good control over the prisoners, as though they were confined within the enclosed prison. I do not think this work would be practical if we were compelled to work the men on the public road, but as it is conducted here it has proven to be a very good way of employing the inmates of this institution.

## Difficulties of Distribution.

The distribution of the crushed stone has not been without difficulties. Owing to the impossibility of securing this past summer from the railroads sufficient number of cars, in fact, at times no cars at all were furnished, the amount of material shipped from the Southern Penitentiary was but a small proportion of what could have been supplied had better transportation facilities been afforded. In nearly every instance where stone was shipped it was impossible to secure cars regularly; one or two would come in one day and then no more would be recieved for one or two weeks, so that the shipments were received very irregularly, with consequent delays and added expense in handling the material. Later in the season not so much trouble was encountered, and when cars were furnished material was shipped with promptness and dispatch.

At Joliet the situation so far as cars were concerned was somewhat better, although there were many points to which stone was shipped for which cars could not be secured regularly, and there was much trouble caused by this fact. Some inconvenience was experienced at the Joliet crusher due to the small storage capacity, so that in some instances where a certain class of material was urgently needed, it was necessary, in order to clear the bins and have the crusher run, to ship material of a size that was not at the time needed At Menard, owing to the large storage capacity, this trouble was not experienced. Arrangements have been practically completed at the Joliet crusher to install a cable way so that a storage pile can be maintained which will not only make it possible to ship the class of material desired at any particular time, but will also enable the crusher to run at all times, whether or not the stone can be used on the roads at a particular time. For instance, in the winter and spring when it is impossible to do work on the roads, the crusher could be kept running, and if a large storage is provided, so much additional material would be available.

The railroads have so far continued the rates granted the Highway Commission which were given in full in the report for 1906.

The problem that is to be met in the free distribution of crushed stone is how the work shall be extended. The practical radius to which material can be shipped is from one hundred to one hundred

and fifty r. s, but by far the larger portion of the material is used within a radius of seventy-five miles.

## Applications and Shipments of Free Macadam.

There is a great demand for the material, far greater than the present capacity of the crushers can furnish, and it would seem if this work is to be carried on that some means should be devised whereby a certain number of convicts could be established at other places and stone depots opened. If such depots are established, two points must necessarily be borne in mind: First, that the material is of suitable quality and in sufficient quantity, and second, that transportation facilities are at hand. In general, a quarry would be more advantageously located if it were possible to ship the stone in the direction of the empty coal car movement, which would be of considerable advantage in inducing the railroads to maintain low freight rates.

In the report of the Highway Commission for 1906 there is shown in table 10 the applications received which totalled 276,365 cubic yards; the total shipments to townships aggregate 39,905 cubic yards. There was shipped in addition to this amount 2770 cubic yards in payment of freight, making a total output of 42,675 cubic yards.

In 1907, there were received 86 applications for crushed stone, totalling 166,140 cubic yards. The applications were from 72 townships and road districts situated in 39 counties. A list of these applications is shown in table 5. The total amount of shipments to the townships is 76,896 cubic yards. In addition to this amount, 20,877 cubic yards were furnished as payment on freight on some of the shipments making a total output of 97,746 cubic yards. Table 6 gives a list of the townships to which shipments were made during 1907.

### Table 5.

*Applications Filed with the State Highway Commission for Crushed Rock, 1907.*

| County. | Township. | Amount applied for cubic yds. |
|---|---|---|
| Bureau | Ohio | 2,000 |
| Clinton | Sugar Creek | 1,000 |
| Coles | Lafayette | 1,800 |
| Cook | Rich | 3,000 |
| Cook | Stickney | 1,500 |
| Cook | ..do.. | 1,500 |
| Cook | New Trier | 700 |
| DeKalb | South Grove | 125 |
| DeKalb | Sycamore | 1,000 |
| DuPage | Downers Grove | 2,000 |
| DuPage | Lisle | 720 |
| Edgar | Ross | 2,000 |
| Fayette | Vandalia | 100 |
| Fayette | ..do.. | 60 |
| Franklin | Benton | 2,500 |
| Gallatin | Shawnee | 3,000 |
| Grundy | Ausable | 2,000 |
| Grundy | Felix | 480 |
| Hancock | Bear Creek | 1,000 |
| Henry | Atkinson | 100 |
| Henry | Galva | 30 |

## *Table 5*—Concluded.

| County. | Township. | Amount applied for cubic yds. |
|---|---|---|
| Henry | Weller | 70 |
| Henry | Western | 120 |
| Iroquois | Belmont | 60 |
| Iroquois | Pigeon Groye | 1,000 |
| Iroquois | Sheldon | 2,000 |
| Jackson | Murphysboro | 2,000 |
| Jackson | Somerset | 2,000 |
| Kane | Compton | 2,000 |
| Kane | Kaneville | 2,500 |
| Kane | ..do.. | 480 |
| Kankakee | Ganier | 2,000 |
| Kankakee | Momence | 2,000 |
| Kendall | Fox | 100 |
| Kendall | Kendall | 2,000 |
| Kendall | ..do.. | 1,000 |
| Kendall | Seward | 2,000 |
| Knox | Lynn | 60 |
| Lake | Deerfield | 2,000 |
| Lake | Ela | 2,000 |
| Lake | Shields | 1,000 |
| Lake | ..do.. | 2,000 |
| LaSalle | Adams | 2,000 |
| LaSalle | Mendota | 2,000 |
| Lee | Harmon | 2,000 |
| Logan | East Lincoln | 4,000 |
| Logan | Prairie Creek | 60 |
| McLean | Mt. Hope | 1,000 |
| Madison | Collinsville | 4,000 |
| Madison | Hamel | 95 |
| Madison | Helvetia | 4,800 |
| Montgomery | Hillsboro | 5,000 |
| Moultrie | Sullivan | 2,500 |
| Ogle | Oregon | 1,000 |
| Piatt | Blue Ridge | 40 |
| Piatt | ..do.. | 30 |
| Piatt | ..do.. | 30 |
| Randolph | Evansville | 900 |
| Randolph | Evansville, R. D. No. 8 | 60 |
| Randolph | Evansville, R. D. No. 12 | 1,500 |
| Randolph | ..do.. | 60 |
| St. Clair | Sugar Loaf | 1,000 |
| Tazewell | Delavan | 400 |
| Tazewell | ..do.. | 3,000 |
| Vermilion | Danville | 2,000 |
| Washington | Nashville | 25 |
| Washington | Oakdale | 75 |
| Wayne | Arrington | 60 |
| Whiteside | Mt. Pleasant | 1,000 |
| Will | Florence | 2,000 |
| Will | ..do.. | 500 |
| Will | Frankfort | 3,000 |
| Will | Jackson | 1,000 |
| Will | Joliet | 5,000 |
| Will | Manhattan | 10,000 |
| Will | New Lenox | 10,000 |
| Will | Peotone | 15,000 |
| Will | Wilmington | 1,000 |
| Will | Wilton | 15,000 |
| Williamson | County Comrs | 4,000 |
| Winnebago | Winnebago | 2,000 |
| Winnebago | ..do.. | 1,000 |
| Winnebago | ..do.. | 1,000 |
| Woodford | Metamora | 2,000 |
| 39 counties.<br>Nine new counties, 30 old. | 72 townships and road districts... | 166,140 |

## Table 6.

*Shipments to Townships and Road Districts of Crushed Rock, Requisitioned by the State Highway Commission from the State Penitentiaries, 1907.*

| County. | Township. | Cubic yards. | Shipped From. |
|---|---|---|---|
| Bond | Burgess | 331 | Menard |
| Bureau | Milo | 433 | Joliet |
| Cook | New Trier | 846 | ..do.. |
| Cook | Oreland | 697 | ..do.. |
| Cook | Rich | 1,650 | ..do.. |
| Cook | Stickney | 637 | ..do.. |
| DeKalb | DeKalb | 3,087 | ..do.. |
| DuPage | Lisle | 657 | ..do.. |
| Edgar | Ross | 2,026 | ..do.. |
| Effingham | Bond | 2,697 | Menard |
| Franklin | Benton | 2,414 | ..do.. |
| Grundy | Felix | 2,440 | Joliet |
| Grundy | Goose Lake | 75 | ..do.. |
| Henry | Atkinson | 359 | ..do.. |
| Henry | Galva | 82 | ..do.. |
| Henry | Geneseo | 958 | ..do.. |
| Henry | Weller | 47 | ..do.. |
| Henry | Western | 120 | ..do.. |
| Iroquois | Belmont | 77 | ..do.. |
| Kane | Campton | 6,402 | ..do.. |
| Kendall | Fox | 108 | ..do.. |
| Kendall | Naausay | 816 | ..do.. |
| Kendall | Seward | 589 | ..do.. |
| Knox | Lynns | 55 | ..do.. |
| Lake | Shields | 2,621 | ..do.. |
| Lake | Waukegan | 2,121 | ..do.. |
| LaSalle | Adams | 822 | ..do.. |
| LaSalle | Mendota | 4,280 | ..do.. |
| Logan | E. Lincoln | 3,658 | ..do.. |
| Logan | Prairie Creek | 85 | ..do.. |
| McLean | Mt. Hope | 1,174 | ..do.. |
| Madison | Hamel | 92 | Menard |
| Madison | Helvetia | 158 | ..do.. |
| Monroe | R. D. No. 9 | 185 | ..do.. |
| Montgomery | Hillsboro | 2,630 | ..do.. |
| Moultrie | Sullivan | 3,440 | ..do.. |
| Piatt | Blue Ridge | 128 | Joliet |
| Randolph | R. D. No. 8 | 39 | Menard |
| Randolph | R. D. No 12 | 225 | ..do.. |
| Rock Island | So. Rock Island | 3,858 | Joliet |
| St. Clair | Sugar Loaf | 1,162 | Menard |
| Union | R. D. No. 4 | 347 | ..do.. |
| Washington | Oakdale | 75 | ..do.. |
| Whiteside | Mt. Pleasant | 1,163 | Joliet |
| Whiteside | Portland | 872 | ..do.. |
| Will | Crete | 382 | ..do.. |
| Will | Florence | 1,681 | ..do.. |
| Will | Frankfort | 2,158 | ..do.. |
| Will | Joliet | 5,333 | ..do.. |
| Will | Lockport | 1,777 | ..do.. |
| Will | Manhattan | 3,749 | ..do.. |
| Will | New Lenox | 2,500 | ..do.. |
| Will | Wilton | 456 | ..do.. |
| Williamson | County Comrs. | 632 | Menard |
| Winnebago | Winnebago | 1,391 | Joliet |
| Woodford | Palestine | 173 | ..do.. |
| Total | | 76,970 | |
| In payment of freight | | 19,625 | |
| Total | | 96,595 | |

## Instructions for Making Limestone Macadam Roads Without Use of a Steam Roller.

Many inquiries have been received as to the method to be followed in placing macadam material on a road. There is some difficulty in giving precise directions which would cover all cases. The object has always been, when crushed stone has been furnished by the commission from the penitentiaries to have the work done better if possible than similar work had been done before in a particular locality. In most instances, however, it is the first experience of the local commissioners with this class of work. Also there is usually but a small amount of money at hand so that the best methods and best results are not always obtainable.

In but one or two instances have townships owned rollers so that all instructions for placing macadam are given, bearing in mind that a roller is not at hand and that the work must be done to the best advantage possible omitting this very desirable feature. Some of the directions are most forcibly impressed by citing a few "dont's."

### Preparing the Road Bed.

There is a great temptation not to give the proper care to the preparation of the road on which the crushed stone is to be placed and we have frequently to repeat, don't put crushed stone on a road until it has been properly rounded and graded up and all holes and depressions filled. Don't fill depressions or mud holes with crushed stone. Earth is the proper material to use and it is very much cheaper.

The first step therefore is to prepare the road to receive the crushed stone. This is quickly done with a road machine or grader operated in such a manner that the earth is thrown outside rather than to the inside of the road. This is very readily accomplished if a furrow is first plowed with the land side towards the outside of the road. The furrow should outline the edge of the macadam. The blade of the road machine is set so that it throws a small ridge of earth to the outside of the road, leaving the center portion as nearly undisturbed as possible. The width of the road-bed shaped in this manner should be about 10 or 12 feet or the same width that it is proposed to have the macadam. The center of the road should be about 6 inches higher than at the side on a 12 foot road. It is well to have this part of the work done as much

ahead as possible so that the traffic can roll the road-bed and compact it especially wherever it has been necessary to fill depressions. If the traffic cuts the road very much, a road grader should be used to smooth it immediately before the stone is spread.

## Side Ditches.

Where the road is through level country, the side ditches should be broad and approximately 30 inches below the center of the finished road. The slope of the side of the ditch towards the road should be about one foot fall to every four feet horizontal, and the side of the ditch towards the fence or the outside of the road could have a somewhat steeper slope, about one foot to every two feet. Ditches made in this manner do not cave in every spring. It is only necessary to cut the weeds to keep such a ditch in good shape. The shoulders and ditches should, if possible, be sown with grass seed or if this is not practicable see that the weeds are cut early in the season and kept cut so as not to smother the grass which will eventually come up and form a close sod which is a great protection to the sides of the ditches and the shoulders as well as adding greatly to the appearance of the road.

## Embankments.

Through low swampy places, a satisfactory road can be built only by first throwing up a suitable embankment so that the road-bed is raised above the general level by at least 18 inches and should be high enough so as to be well above all ordinary water that may stand alongside the road. The embankment should be not less than 22 feet wide on top, preferably 25 feet, and should have as gradually sloping sides as possible. To build an embankment properly the earth should be spread in layers of not over 12 inches thick and wagons and teams driven over all parts of it so that it will become compacted as much as possible during construction. The earth should be spread at first to the total width that it is necessary to make the embankment, including the slopes. For example, if the embankment is to be 25 feet wide at the top and is to be built 4 feet high and the side slopes are to be two horizontal to one vertical, it is evident that the embankment will extend to each side of the road for eight feet so that the distance from the toe of one slope to the toe of the other will be 16 feet plus 25 feet or 41 feet. Very often the embankment is constructed by spreading the earth on the bottom merely for the width that it is desired for the top of the embankment which is built up, and slopes made by dumping the earth over the edge. This will not give as solid an embankment nor one that will hold its shape as well.

## Construction of Shoulders.

The earth which is thrown up at the sides and forms the shoulders prevents the stone spreading and the traffic displacing the edge of the stone. The shoulders should be formed before the stone is spread. In a number of instances the stone has been placed upon the road with no attempt whatever to form shoulders. This is not the right way.

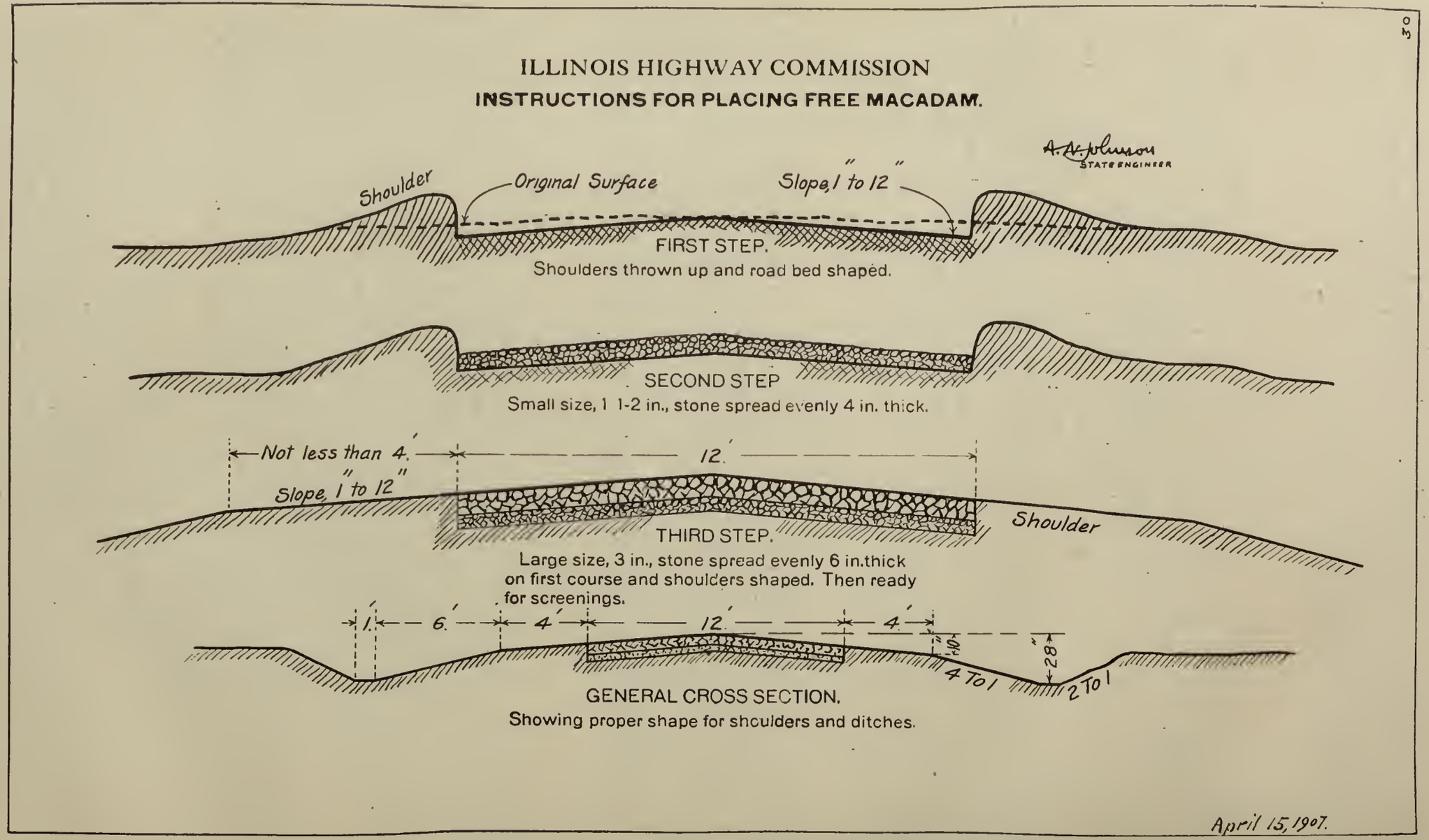



Fig. 12. Illustrating steps in construction of macadam road.

After the second layer of stone has been spread, the earth shoulders should be smoothed down to conform to the surface of the road and should be sloped towards the gutters with a slope of one inch to the foot for at least a width of 4 feet on both sides of the stone.

## Blind Side-Drains and Under-Drains.

The cut shown in Figure 12 illustrates the various steps here described. As the work progresses, there should be cut through the shoulders at intervals of about 50 feet, trenches about the width of a shovel and to such a depth that the water will run readily from the road-bed to the side ditches. These trenches should be filled with broken stone or gravel, whichever may be at hand, and about the same thickness as the layer of stone in the first course. The remainder of the trench is filled with earth so that these drains do not show on the surface of the shoulder. The side drains and shoulder drains tend to keep the road-bed dry and also to drain the shoulders and are, in no case, to be omitted.

If there is under ground water as shown by a seepy or quaky place, it will be necessary to run a tile drain through such places and carry it to an outlet in the side ditches. If this is not done, no amount of stone which could be put in such a place will be effective to prevent a mud-hole from eventually forming. In very level country where good drainage is difficult to secure, it is important to have the center of the road elevated as much as possible so that the foundation of broken stone will at all times be well above the level of the water in the side ditches.

## Spreading First Course of Stone.

The second step is to spread the first course of stone.

If it is planned to put a 10-inch layer on the road, don't put it all on in one layer. It should be put on in two layers. As practically all the stone obtainable in Illinois is limestone which is but moderately hard, it is better to reverse the usual order of making a stone road and put in the first course or on the bottom of the road the 1½ inch size material which should be evenly spread for a thickness of four to five inches. A strong-toothed rake is one of the best implements of the road maker. Stone that is spread by a rake will be stirred up and the small pieces will take their natural position at the bottom of the layer and the stone will, therefore, compact very much more quickly and the larger pieces will not tend to work to the surface as they will inevitably do if placed at the bottom. As they come to the surface the whole layer is disturbed and loosened.

## Spreading Second Course of Stone.

The next step is to spread the second layer or top course. This should consist of the three inch material which is evenly spread with rakes as in the case of the lower course of stone.

A word should be said about the method used to spread stone. The essential thing is to get an even layer of material. This cannot be done if the stone is raked from a pile as it is dumped upon the road as the center of a pile of stone is always more compact than the material that is raked to the edges. It is, therefore, necessary to see that all the stone is rehandled.

A very convenient way to measure the thickness to which the stone is spread is by blocks of wood. It the material is to be spread 5 inches thick, then the blocks should be cut to measure 5 inches in all dimensions so that no matter which way the block may be set, it will be five inches high. At least twelve of these blocks should be made. They should be set three in a row upon the roadbed, one in the center and one on either side. Three more should be placed across the road-bed in a similar position about six or eight feet from the first row. As soon as the stone is spread around the first row of blocks, they are taken out and set ahead and the process repeated. There should be a similar set of blocks for each layer of stone. As before noted, the road-bed should be shaped true enough so as not to require more stone in one place than in another to secure an even surface.

Stone cannot be spread "by eye." When it is borne in mind that a variation of but one inch in thickness means 244 tons per mile of road, 12 feet wide, the importance of using only so much material as is necessary is evident.

Sometimes stakes are set on either side of the road and a string stretched from one to the other. The stone can be very evenly spread by this method but it is far more bother than the use of the blocks and is no more accurate.

## Screenings or Binder Course.

After the last or second course is spread and the shoulders have been formed, the road is ready for the screenings or stone dust. Each shovelful of screenings should be spread in such a manner that it will cover as large an area as possible, thus sweeping the screenings into the interstices of the broken stone. Only a part of the screenings should be put on at first. Allow the traffic to go over the road for a week then fill the ruts with stone and put on more screenings in those places where it is shown that they are needed. A small amount of fine gravel makes an excellent binder for limestone.

## Filling Ruts.

It will be necessary in order to obtain good results that a man be employed to go over the road frequently and as fast as ruts are formed see that stone is raked into these ruts and they are kept filled. If this is done throughout the first season, the road will eventually become compacted and fairly smooth and a satisfactory surface will result, particularly where limestone is used which is comparatively soft and binds readily. Do not attempt to fill a rut or depression in a macadam road with screenings or pieces of stone that are smaller than those used in the construction of the upper course.

## Instructions for Placing Gravel.

Gravel roads should be built in much the same manner as already outlined for building macadam roads. Particular attention should be paid to thoroughly spreading and raking the gravel so that the finer parts are sifted to the bottom leaving a layer of the larger pebbles and pieces of stone on the top to form a wearing surface.

There are many cases where the gravel is found very close at hand but of such a sandy nature that it will not form a good road surface. Such gravel can, however, be used to advantage at the bottom of the road which could then be covered with a four or five inch layer of crushed stone. In this way the crushed stone would go very much further than if the road was built entirely of stone. A small amount of fine gravel makes a good binder for a layer of limestone, in fact it has been found to give a better bond than is obtained with limestone screenings alone.

The usual method of dumping one load of gravel at the side of another and leaving the traffic to spread and compact it causes far too much inconvenience to traffic and should not be permitted.

The question is frequently raised whether macadam or gravel should be spread in the center of the road or at one side, having an earth road on one side and gravel on the other. The best practice is to place the macadam or gravel in the center and, if there is sufficient room, a side road can be made on either side. In nearly every instance observed where the gravel road is at one side and the earth road at the other, the earth road, wherever it was used to any extent, was soon worn down considerably below the gravel or macadam so as to form a terrace that prevents traffic from turning readily from the gravel to the earth road or vice versa. This makes it more difficult to provide for proper drainage; moreover a road constructed in this manner always presents an unsightly appearance.

## Care of the Road Side.

Appearance counts. It is worth as much to the road as to the houses and grounds alongside it. A beautiful road-side attracts people and enhances the value of the property in the neighborhood.

The first thing to be encouraged is the growth of a good sod from the edge of the travelled way to the fence line. Keep the weeds cut and give the grass a chance to grow. Where there are no trees, set them out. There is an opinion in the minds of many that trees harm a road, claiming that they retain the moisture and are in other ways baneful. Wherever the road is bad in the neighborhood of trees, the trouble is not with the trees but with the road. If the road were properly constructed and drained, the trees would cause no further trouble. In fact, with a macadam road, the moisture that would be held in the surface in the summer time would be a distinct advantage. In the winter time, if the low-hanging limbs are trimmed, there will be practically as much sun and wind come upon the road as though there were no trees, while their value in the summer time cannot be over stated.

Trees along the road side should not be cut down at the caprice of an individual commissioner or even of the land owner alongside. Trees are a public asset and should be most jealously guarded and cut only after due consideration by public officials who should be chosen for this purpose, or have these duties imposed upon existing public officials, but in any event, prevent the wanton destruction of beautiful shade trees on the road side. Care for the trees you have, set out new ones; it pays.

A. Woodside Township, Sangamon County. Springfield experimental road built in 1906. View taken March 3, 1908. In foreground is seen ravelled gravel portion of road, immediately beyond is limestone. The junction of the stone and gravel is sharply defined.

B. Mt. Hope Township, McLean County. Experimental limestone, macadam road built in 1906. View taken March 7, 1908.

# Experimental Macadam Roads.

## Report on Roads Built in 1906.

In the report of the commission for 1906 will be found on page 88 a detailed description of the method of construction of the five experimental macadam roads that were built in that year.

These roads have now passed through one entire year and part of their second winter. They were recently inspected and careful note taken of their condition and surrounding circumstances.

The Salem road, where the soil is yellowish clay and somewhat sticky, shows the best condition of the surface, which is practically as good as the day it was completed. The traffic has spread over it to a reasonable amount and there is as yet no indication of ruts forming.

The road near Greenville built in 1906 is unprotected at either end. The soil here is a clay soil somewhat more sticky than at Salem. The south end of this road, which was not finished, shows ruts, and the surface is not smooth. The finished portion of the road is in good condition but there is more evidence in this road of the formation of ruts than on any of the other roads. The surface however is fairly smooth and there is no indication of ravelling.

The road at McLean has held in excellent shape. Here the soil is black loam, very much more sticky than in either of the other instances cited.

This road was inspected in March, 1908, and presented a better appearance than it did the previous fall. (See plate 6, figure B.) The traffic had rolled the road so that the surface appeared more compact. No ruts have as yet formed, with the exception of one or two hundred feet on the west end, which developed slight ruts soon after the road was constructed, and may be due to the fact that this was the last end completed and did not receive as much rolling as the other portions of the road.

The Springfield road suffered the worst conditions of any. This mile of road at either end has earth roads of black and extremely sticky soil. The mud was collected by the wagon wheels and deposited on the ends of the road for a distance of 100 to 1,000 feet. The amount of mud varied from day to day. On some days observed, it was perhaps five to six inches deep and a week later there would be only an inch or two. As soon as the earth roads dried practically all the mud would be washed away and the road surface left entirely clean. The south end of the road for about 200 feet was finished with 1½ inch

material. The top of this was very much loosened and displaced by the action of the sticky mud which picked it up. This action, however, ceased at the point where the three inch material was used for the surface.

At the north end of the road the character of the soil appears more sticky than that adjacent to any of the experimental roads which have been so far constructed. In March, 1908, when the road was last inspected, the surface had been seriously disturbed and the material pulled out, leaving the surface of the road with humps and hollows. This disturbance of the surface is more pronounced near the end of the road and continues less noticeably for six or seven hundred feet. The central portion of the road, however, shows no effect whatever from action of mud, but part of the road on which an experiment in the use of gravel was made shows the effects of the wear and tear and has never compacted. (See plate 6, Fig. A.) At the time the road was constructed the gravel used did not compact under the roller, and it was doubtful what the results would be. The quality of the gravel was not uniform, and the poorest gravel was removed in the fall of 1906 and replaced with stone. This section of the road is undisturbed and in good condition.

It was thought best to leave the gravel through the season of 1907 before making any final repairs, but it will be necessary to remove the gravel and resurface the road with crushed stone. The four or five blocks of mud road at the north end of this road will be paved with brick, so that in the future there will be no trouble from the mud on this end of the road, which will be reshaped, adding what small amount of material may be necessary to put the surface in good condition.

The two DeKalb roads were built in two sections, one north and the other south of town, but they were not built under the immediate supervision of the commission. These roads do not show any defects from the failure of the foundation. The surface of the south road, on which too large a quantity of screenings was used, is somewhat uneven owing to the effect of the traffic which picked up the screenings and deposited them in piles. This was noticed particularly on the south portion of the south road. On the northern portion of this road, where the screenings were not put on so thickly, this was not so noticeable and the surface was much more even. The north road is reported to be in better condition than the south section.

From the experience gained with the experimental roads constructed in 1906, and what has thus far been observed with those constructed in 1907, some conclusion can be drawn which will assist materially to decide whether macadam road construction is one that is feasible under all soil conditions found in Illinois.

First, it can be definitely stated that so far as the foundation of the road is concerned, there is no difficulty whatever with macadam construction. In fact, the soils which are regarded as making the worst conditions of road, the sticky clay and gumbo soils, apparently furnish the most solid foundation; that the most treacherous conditions exist on hilly roads where seepy places occur and where there is often encountered a more open or porous soil.

Second, that the chief deterioration in macadam construction is from the effect of the mud which is tracked upon the road, and that this effect does not seem to be serious, with the exception of the most sticky gumbo soils. Under these conditions, if the macadam road is to be economically maintained, it is necessary to provide for some special means of protecting the exposed end of the road. One method would be for drivers to take the precaution to clean the mud off of their vehicles at the end of the road and thus avoid all further trouble. Where sand or sandy gravel can be obtained, protection is afforded by spreading this upon the surface of the mud road at the end of the macadam.

It has been noticed in many localities that the soil is usually very much more sticky in the low places than on the tops of the knolls. In such instances it is evident that a macadam road should not end in the hollow, where the stickiest soil exists, but be carried beyond to some point where a different character of soil is found.

It will be possible, however, to draw more satisfactory conclusions as greater experience is obtained with the various experimental roads that have been built.

## Petitions for Experimental Roads Received in 1907.

Much interest has been manifested in the experimental macadam construction as undertaken by the State Highway Commission. Many more requests for this work were received than the limited means available would permit to be undertaken. In general, the plan of coöperation with the local communities was that they should furnish all labor and pay freight on the crushed stone, which would be furnished free at the prison crushers. The Highway Commission supervised the work and furnished a steam roller and sprinkling cart without cost to the local people. In a few instances freight was paid in ballast.

## Table 7.

*Townships Petitioning for Experimental Roads, 1907.*

| County. | Township. | Date. |
|---|---|---|
| Clark | Casey | Mar. 9, 1907 |
| Coles | Mattoon | July 9, 1907 |
| DuPage | Milton | Oct. 21, 1907 |
| Kane | Elburn | Feb. 9, 1907 |
| Kendall | Kendall | April 30, 1907 |
| Lake | Waukegan | April 27, 1907 |
| LaSalle | Mendota | July 8, 1907 |
| Macon | Whitmore | July 9, 1907 |
| Madison | Collinsville | May 25, 1907 |
| ..do | Helvetia | Mar. 7, 1907 |
| ..do | St. Jacobs | Dec. 10, 1906 |
| Menard | Petersburg | Jan. 31, 1907 |
| Montgomery | Hillsboro | Mar. 7, 1907 |
| Piatt | Bement | July 9, 1907 |
| Vermilion | Danville | Sept. 16, 1907 |
| Will | Florence | July 9, 1907 |

## Method of Construction.

The method of construction was the same as described in the 1906 report. The small size stone—one and one-half inch size—was placed as the bottom layer, on which was spread the three-inch material bonded with screenings. Each layer was rolled thoroughly, as well as the road bed. Blind side drains were cut through the shoulders every fifty feet on each side of the road. These drains are necessary where the shoulders are made of clay or other soil retentive of moisture, and are a very important feature of the construction.

## Description and Comparison of Costs of Experimental Roads Built in 1906 and 1907.

A comparison of the cost of the work done in 1907 with that of 1906 will show, in general, an increase which may be accounted for by the fact that in no instances in the past year has the work proceeded with dispatch. This was occasioned by two features which were beyond control, either of the State Highway Commission or of the local people who were interested in building the various roads. The first of these was bad weather, which frequently stopped the work for a week or more at a time. The second was the irregular shipments of the material from the penitentiaries, on account of the inability to secure cars when needed. There were times on some of the jobs when but a few cars of stone were received in a month.

## First Street Road, DeKalb, DeKalb Township, DeKalb County.

The road selected at DeKalb for experimental work during 1907 is located one-half mile south of DeKalb, beginning at the end of the brick pavement and extending south 4,770 feet on what is known as South First street.

This road had been constructed of macadam by the local highway commissioners, with the coöperation of the U. S. Office of Public Roads, as an object lesson in 1904. The reason it was necessary to resurface this road so soon is that the material of which it was built was a rather soft limestone, the one and one-half inch size being used for a wearing surface, which was not sufficient to sustain the heavy traffic which was confined entirely to one track. As a result, deep ruts had formed and also some chuck holes, so that the surface was in such a bad condition that it required reconstruction.

The new surface which was put upon the road was composed of stone shipped from the Joliet penitentiary, using the three-inch material. The old surface was broken up to a width of twelve feet by spikes placed in the wheels of the steam rollers. Shoulders were formed on the sides by a road grader. The loosened material of the old road was shaped to give a one-inch to the foot crown. After being thoroughly harrowed, to allow the small material to sift to the bottom, it was thoroughly rolled. On this, as a foundation, was laid a six-inch course of three-inch material, which was rolled and bonded with stone dust.

The money for this work was provided from the town funds. The work was begun on November 18 and completed on December 17, the actual number of working days being eighteen.

The quantities and amount of labor cost are as follows:

DE KALB.

(Resurfacing).

| | |
|---|---|
| Length of road | 4770 ft. |
| Width of macadam | 12 ft. |
| Cubic yards of stone | 760 |
| Square yards of macadam, re-surfaced | 6360 |
| Average haul | 1-½ miles. |
| Labor, men | $2.25 per 9 hour day |
| Labor, men with teams | 4.50 per 9 hour day |

*Cost of—*

| | |
|---|---|
| Spiking up | $ 15 00 |
| Harrowing | 2 43 |
| Excavation | 19 87 |
| Unloading stone | 38 25 |
| Hauling stone | 370 00 |
| Spreading stone | 44 00 |
| Trimming shoulders | 28 25 |
| Rolling, coal and sprinkling | 100 00 |
| Superintendent and watchman | 60 00 |
| Total | $670 71 |

*Cost per Cubic Yard Placing Stone—*

| | |
|---|---|
| Unloading stone | $.050 |
| Hauling stone | .486 |
| Spreading stone | .057 |
| Rolling, coal, men and sprinkling | .154 |
| Total | $0.747 |

*Labor Cost per Square Yard—*

| | |
|---|---|
| Excavation | $0.004 |
| Placing stone | .088 |
| Trimming shoulders | .003 |
| Superintendent and watchman | .010 |
| Total | $0.105 |

EFFINGHAM ROAD, DOUGLAS TOWNSHIP, EFFINGHAM COUNTY.

This road, known as the Effingham-Siegal road, extends one mile north of the city limits, crossing the Illinois Central railroad and passing the cemetery. The grades do not exceed 2 per cent. A four foot by four foot concrete culvert was built to accommodate a small stream. It was not necessary to use tilings as the ground drained readily, the soil being a light prairie loam.

The money was furnished by the local commissioners from the township funds. The stone was donated by the State and shipped from the Menard penitentiary. The work was hindered by much rain and irregular shipments of stone caused by the delay in securing

cars, and the congestion of railroad traffic. The unloading and hauling of stone was done by contract, the spreading of stone and all other work was done by day labor. This work was begun at the far end and completed towards town. (See plate 7).

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 5,320 feet |
| Width of macadam | 12 feet |
| Square yards of macadam | 7,093 |
| Cubic yards of stone in road | 2,697 |

Labor—men, 15 cents per hour; team and man, 30 cents per hour.

*Cost of—*

| | |
|---|---|
| Excavation | $ 433.07 |
| Shaping road bed | 233.92 |
| Unloading and hauling stone | 471.79 |
| Spreading stone | 264.38 |
| Trimming shoulders | 50.96 |
| Rolling, water, sprinkling, coal, oil, repairs, etc. | 358.54 |
| Superintendent and incidental expenses | 280.75 |
| Total | $2,093.41 |

*Unit Cost of Placing Stone Per Cubic Yard—*

| | |
|---|---|
| Unloading and hauling stone | $0.175 |
| Spreading stone | .10 |
| Rolling, water, sprinkling, coal, oil, repairs, etc. | .1329 |
| Total cost per cubic yard | $0.408 |

*Labor Cost Per Square Yard—*

| | |
|---|---|
| Excavation | $0.061 |
| Shaping road bed | .033 |
| Placing stone | .154 |
| Trimming shoulders | .007 |
| Superintendent and incidental | .040 |
| Total cost per square yard | $0.295 |

## Elburn Road, Campton Township, Kane County.

The conditions that made possible the construction of this experimental road at Elburn are somewhat unique, as the entire cost of the work was borne by Mr. John Stewart of Elburn, to whom the community is indebted for this very practical gift.

It commences at the village limits and extends north two miles, on what is known as the Lily Lake Road. The soil is varied, the first and last quarter miles are prairie loam, and the remainder clay. The entire distance had been improved with gravel which had, however, been very largely lost by neglect and wear. Some places had been repaired by hauling in large boulders which made a very rough surface. The country is rolling prairie and the old gravel surface was largely disregarded, as the grades were reduced by increasing cuts and fills. In places the cuts are ten feet while the maximum fill is about five feet. The stone was shipped from the penitentiary at Joliet. The work was begun at the far end and completed toward the town, which method is not to be generally recommended.

A. Douglas Township, Effingham County. Showing character of experimental road before improvement. Yellow clay soil.

B. Douglas Township, Effingham County. Finished experimental road, limestone macadam. Built in 1907.

Three small, circular culverts were built in the place of wooden ones, and one five-foot culvert was rebuilt with a concrete top, on the old stone abutments which were in good condition.

The work was greatly handicapped by the amount of rain, more than one-third of the time being thus lost. Another delay in the work was caused by the irregular shipment of the stone. The railroad company, being crowded with traffic, would sidetrack cars until a number had accumulated, then all would be sent in at once. This multiplied the trouble for just as likely as not cars would be delayed when the weather was fair and shipped when the weather was bad. These unavoidable delays necessarily increased the cost of the work.

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 10,560 feet |
| Width of macadam | 12 feet |
| Square yard of macadam in road | 14,080 |
| Average haul of stone, 1½ miles. | |
| Cubic yards of stone | 6,400 |
| Labor—men, 20 cents per hour; team and man, 40 cents per hour. | |

*Cost of—*

| | |
|---|---|
| Excavation | $1,234.20 |
| Shaping road bed | 443.00 |
| Trimming shoulders | 128.00 |
| Unloading stone | 419.20 |
| Hauling stone | 2,021.20 |
| Spreading stone | 361.80 |
| Rolling, oil, coal, supplies and sprinkling | 667.00 |
| Superintendence and watchman | 516.00 |
| Concrete bridges | 123.00 |
| Total | $5,913.40 |

*Unit Cost Per Cubic Yard Placing Stone—*

| | |
|---|---|
| Unloading stone | $0.065 |
| Hauling stone | .316 |
| Spreading stone | .056 |
| Rolling | .104 |
| Total | $0.541 |

*Labor Cost Per Square Yard Finished Macadam—*

| | |
|---|---|
| Excavation | $0.087 |
| Shaping road bed | .031 |
| Trimming shoulders | .010 |
| Placing stone | .246 |
| Superintendence and watchman | .036 |
| Concrete work | .010 |
| Total | $0.420 |

## Lincoln Road, East Lincoln Township, Logan County.

The experimental road at Lincoln leads east from the city limits a distance of two miles, and is known as the East and North Lincoln road. The country is slightly rolling, the grades not exceeding two feet in the hundred. The stone was shipped from the Joliet peniten-

tiary. The freight on this shipment was paid in ballast delivered to the railroad company.

The local commissioners paid the cost of the concrete culverts and the grading, while the unloading, hauling and spreading of stone was paid by subscription, as well as the handling of the shale used in the foundation. The subscription was raised by a local improvement association formed for this particular purpose and much credit is due those who had this matter in hand and gave so liberally both in time and money.

The construction was made 12 feet wide, 11 inches deep, of which the lower course of 6 inches was made of shale from the dump of a coal mine, which handled easily and compacted to form a firm base; the top course was made of 3-inch limestone. (See Plate 8.)

A part of the stone preceded the road work and was placed in storage piles. This, to some extent, facilitated the work, but added to the cost of handling the stone. The work was much delayed by rainy weather and consequent condition of the road which made it impossible for weeks at a time to haul any material.

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 11,270 feet |
| Width of macadam | 12 feet |
| Square yards of macadam | 15,027 shale base |
| Average haul of stone | 2 miles; shale, 1½ miles |
| Cubic yards of stone in road | 3,658; shale, 3,160 |
| Labor—men, 17½ cents per hour; team and man, 35 cents per hour. | |

| *Cost of—* | |
|---|---|
| Excavation | $ 75.43 |
| Shaping road bed | 379.04 |
| Unloading stone from cars | 508.25 |
| Hauling stone | 1,735.13 |
| Spreading stone | 471.82 |
| Loading shale | 383.82 |
| Hauling shale | 1,044.77 |
| Spreading shale | 293.42 |
| Trimming shoulders | 245.25 |
| Rolling, coal, oil, supplies, sprinkling | 963.00 |
| Hardware, tools, superintendence, etc | 583.55 |
| Total | $6,683.01 |

| *Unit Cost of Labor Per Cubic Yard—* | |
|---|---|
| Unloading stone | $0.138 |
| Hauling stone | .474 |
| Spreading stone | .129 |
| Unloading stone | .121 |
| Hauling shale | .33 |
| Spreading shale | .092 |
| Rolling and sprinkling (both materials*) | .141 |
| Total | $0.793 |
| Total labor cost placing stone | $0.742 |
| Total labor cost placing shale | 0.544 |

* Both materials counted as all stone.

A. East Lincoln Township, Logan County. Condition of road before experimental road was laid.

B. East Lincoln Township, Logan County. Finished experimental, limestone macadam road, built in 1907. This view is about 1,200 feet north of view above, both looking in the same direction.

*Cost Per Square Yard of Finished Road* (both materials)—

| | |
|---|---|
| Excavation | $0.005 |
| Shaping road bed | .026 |
| Placing stone and shale | .359 |
| Trimming shoulders | .016 |
| Superintendence, watchman and waterboy | .039 |
| Total labor cost per square yard of finished road | $0.445 |

## Highland Road, Helvetia Township, Madison County.

The aid of the Commission had been requested by the commissioners and a number of citizens of Highland to construct a gravel road, money for the purpose being raised by subscriptions and in part from public funds. It was the purpose to build the road of local gravel, the State Highway Commission to furnish the supervision and machinery for the work. As the work progressed, it was found that gravel of the character which it was at first supposed would be available, could not be had and that a satisfactory road could not be built with such material as it was possible to obtain. Owing to delays at other points, due to weather conditions and insufficient car supply, shipments of crushed stone from Menard to begin the work at this point were necessarily delayed, so that winter approached before it was possible to secure a sufficient quantity of limestone to surface the gravel, which it was believed would be sufficient for a foundation course.

It was necessary to leave the work in this unfinished condition. It is expected the road will be completed in 1908.

## Hillsboro Road, Hillsboro Township, Montgomery County.

The experimental road at Hillsboro begins at the end of the brick pavement on Main street and extends southeast 4300 feet on the old Hillsboro-Vandalia road. This road is 12 feet wide with a depth of stone of 10 inches. The foundation is red clay. For most of the distance the roal is level, having, however, about a 3 per cent grade at its junction with the pavement.

The construction of the road was made possible by the levy of a special township tax of 30 cents per $100.

The stone was furnished free by the State f. o. b. cars at the Menard prison. Three reinforced concrete culverts were built on the road, of ten, three and four foot spans, respectively. These, as well as the road, were built by day labor according to plans and specifications furnished by the State Highway Commission.

There were no serious difficulties encountered in the construction of this road, as the weather was good most of the time. One or two seepy places were found, which were taken care of by blind drains. The stone shipments, however, were extremely irregular and much time was lost on this account. Days and weeks of the best weather sometimes passed without a single car of material.

Winter stopped the work before a mile was completed. The last car of stone was dumped loosely so as to form a mud break for incom-

ing vehicles. Next to this loose stone is a section 300 feet long which is finished with 1½-inch stone instead of 3-inch stone.

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 4,300 feet |
| Width of macadam | 12 feet |
| Square yards of macadam | 5,750 |
| Average haul of stone | 1½ miles |
| Cubic yards of stone in road | 2,500 |

Labor—$2 for men, 9 hours; $4 for two-horse team, 9 hours.

*Cost of—*

| | |
|---|---|
| Excavation | $ 454.65 |
| Shaping road bed | 228.25 |
| Unloading stone from cars | 215.33 |
| Hauling stone | 1,584.40 |
| Spreading stone | 203.23 |
| Trimming shoulders | 143.40 |
| Rolling, coal, oil, supplies, sprinkling, superintendence ($3 day) | 222.00 |
| Watchman and water boy | 253.46 |
| Total | $3,303.72 |

*Unit Cost Per Cubic Yard of Placing Stone—*

| | |
|---|---|
| Unloading stone | $0.086 |
| Hauling stone | .633 |
| Spreading stone | .081 |
| Rolling and sprinkling | .096 |
| Total labor cost of placing stone | $0.896 |

*Cost Per Square Yard of Finished Macadam—*

| | |
|---|---|
| Excavation | $0.079 |
| Shaping road bed | .040 |
| Placing stone | .348 |
| Trimming shoulders | .025 |
| Superintendence, watchman and water boy | .082 |
| Total labor cost per square yard of finished macadam | $0.574 |

## McLean Road, McLean Village, McLean County.

The experimental road at McLean, an extension of the road built at that place in 1906, begins at the public square in the village and extends east and south to the city limits, where it joins with the road built last year. A part of this extension was built 16 feet wide for a distance of 515 feet, the remaining 925 feet was built 12 feet wide; the depth of stone was 10 inches.

This construction was somewhat difficult on account of concrete crossings and railroad tracks, to which the grades had to conform. On account of bad weather, fifteen days out of forty-five were lost, leaving thirty working days in which the road was building.

The financing of this work was by private subscription raised by an improvement society created for this particular purpose.

The stone was furnished by the State, f. o. b. cars at the Joliet penitentiary. The work of handling stone and grading was completed just as freezing weather began and this somewhat hindered finishing the surface in the best manner.

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 1,440 feet |
| Width of macadam, 515 feet, 16 feet wide | 925 feet, 12 feet wide |
| Sq. yds. of macadam (125 sq. yds. in approaches) | 2,275 |
| Average haul of stone | 700 feet |
| Cubic yards of stone in road | 800 |

Labor—men, 25 cents per hour; teams, 50 cents per hour.

*Cost of—*

| | |
|---|---|
| Excavation | $ 89.00 |
| Shaping road bed | 97.00 |
| Unloading stone from cars | 136.75 |
| Hauling stone | 148.18 |
| Spreading stone | 65.20 |
| Trimming shoulders | 61.65 |
| Rolling, coal, oil, supplies, sprinkling, superintendent, etc. | 207.05 |
| Total | $804.83 |

*Unit cost of Labor Per Cubic Yard Placing Stone—*

| | |
|---|---|
| Unloading stone | $0.159 |
| Hauling stone | .179 |
| Spreading stone | .081 |
| Rolling and sprinkling | .146 |
| Total labor cost placing stone | $0.565 |

*Labor Cost Per Square Yard of Finished Macadam—*

| | |
|---|---|
| Excavation | $0.039 |
| Shaping road bed | .042 |
| Placing stone | .205 |
| Trimming shoulders | .027 |
| Superintendent | .040 |
| Total labor cost per square yard | $0.353 |

## Rock Island Road, South Rock Island Township, Rock Island County.

The experimental macadam road at Rock Island, known as the Cemetery Road, in South Rock Island Township, begins at the end of the brick pavement on Tenth street and extends south 4500 feet to the cemetery gate. The soil is light colored clay, which became very muddy in wet weather, although not particularly sticky. The land on the east side of the road rises somewhat abruptly. Towards the southern end of the road, water which collected in the hillside caused seepy places in the road, which were underdrained with tile placed at one side, and about three feet below the center of the road. The macadam was built ten inches thick for a width of twelve feet in the center, which is flanked by four feet of macadam on either side, built but five inches thick, making a total width of twenty feet that was macadamized. See Plate 9.)

The money for this work was raised by subscription, the major part being furnished by the Ladies Cemetery Improvement Association; the president, Mrs. Benjamin T. Cable, taking a very active interest in the project. The local commissioners also paid a proportion of the work and a small amount was paid by property owners along the road.

The stone was furnished from the Joliet penitentiary, part of the freight being paid in ballast. Approximately half of the material was shipped ahead of the work and hauled to a vacant lot near the north end of the road and stored. The work was begun in April and finished in August, 1907. The cost was increased by the long haul of the stone, which averaged about a mile and a half, by delays due to irregular shipments of material, and bad weather.

Quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 4,500 feet |
| Width of macadam | 20 feet |
| Square yards of macadam | 10,000 |
| Average haul | 1½ miles |
| Cubic yards of stone in road | 3,800 |

Labor—men, per day of 9 hrs., $2.50; team and man per day of 9 hrs., $5.

*Cost of—*

| | |
|---|---|
| Excavation | $ 301.81 |
| Shaping road bed | 175.10 |
| Unloading stone | 515.84 |
| Hauling stone to storage | 771.84 |
| Hauling stone to road | 481.66 |
| Hauling stone from storage to road | 655.21 |
| Loading from storage | 188.42 |
| Hauling sand, cinders and tile | 97.83 |
| Spreading stone | 283.00 |
| Trimming shoulders | 337.53 |
| Rolling, coal, supplies, oil and sprinkling | 530.87 |
| Superintendence | 178.89 |
| Watchman | 164.10 |
| Water boy | 15.90 |
| Tile ditching | 67.39 |
| Masonry | 26.96 |
| Total cost | $4,792.35 |

*Cost of Placing Stone Per Cubic Yard—*

| | |
|---|---|
| Unloading stone | $0.135 |
| Hauling stone to storage | .300 |
| Hauling stone to road | .394 |
| Hauling stone from storage to road | .254 |
| Loading from storage | .073 |
| Spreading | .074 |
| Rolling and sprinkling | .140 |
| Total cost placing stone per cubic yard | $1.370 |

*Labor Cost Per Square Yard of Finished Macadam—*

| | |
|---|---|
| Excavation | $0.030 |
| Shaping | .018 |
| Placing stone | .290 |
| Trimming shoulders | .036 |
| Superintendent, watchman and water boy | .035 |
| Rolling, supplies, etc. | .052 |
| Incidentals | .018 |
| Total labor cost per square yard | $0.479 |

A. South Rock Island Township, Rock Island County. South end of road before improvement, showing general character of old road surface.

B. South Rock Island Township, Rock Island County. Experimental, limestone macadam road built in 1907. View taken April 4, 1908.

## Sullivan Road, Sullivan Township, Moultrie County.

The location of the experimental road at Sullivan extends east on the Jonathan creek road for one mile, beginning at the end of a brick pavement at the city limits. The soil is a heavy black loam and very sticky. A part of the work of grading was done by the local commissioners. The stone for the work was furnished by the State from the prison at Menard. The freight on the stone was paid in ballast. The hauling and spreading of the stone was done by contract at 35 cents per cubic yard and $3.50 per day for teams which did a part of the grading.

The remainder of the money necessary for this work was raised by private subscription. Some hauling was donated, but the major part was done by contract. The work was handicapped by bad weather and irregular car service. (See plate 10.)

The quantities, amount of work and labor cost are as follows:

| | |
|---|---|
| Length of road | 5,800 feet |
| Width of macadam | 12 feet |
| Square yards of macadam | 7,700 |
| Average haul of stone | 1½ miles |
| Cubic yards of stone in road | 3,200 |

Labor—men, $1.75 for 10 hours; teams, $3.50 per day.
Water, 50 cents a tank, 450 gallons.

*Cost of—*

| | |
|---|---|
| Excavation | $ 75.43 |
| Shaping road bed | 680.76 |
| Unloading stone from cars | 306.96 |
| Hauling stone | 713.44 |
| Spreading stone | 382.70 |
| Rolling, coal, oil, supplies, sprinkling, superintendence, hardware and tools | 870.09 |
| Trimming shoulders | 470.29 |
| Total | $3,499.67 |

*Unit Cost of Labor Placing Stone—*

| | |
|---|---|
| Unloading stone | $0.096 |
| Hauling stone | .223 |
| Spreading stone | .120 |
| Rolling, sprinkling, supplies, etc. | .150 |
| Total labor cost placing stone | $0.589 |

*Labor Cost Per Square Yard of Finished Macadam—*

| | |
|---|---|
| Excavation | $0.010 |
| Shaping road bed | .088 |
| Placing stone | .244 |
| Trimming shoulders | .061 |
| Superintendent and watchman | .051 |
| Total labor cost per square yard of finished macadam | $0.454 |

## An Estimate of the Cost of Macadam Roads.

The data that have been obtained for the cost of work done the past two years furnishes some definite information as to the probable cost of macadam roads. There have been constructed in the past two years, twelve pieces of road, totaling 13.76 miles in length, on which

44,120 cubic yards of material were used, not including the resurfacing at DeKalb in 1907 and the unfinished work at Highland.

Exclusive of the cost of the material, the total labor expense of preparing the roads, spreading the stone, cutting side drains and, in fact, all work necessary to make the work complete, was $41,543.44. Table 8 shows how this amount is apportioned to the various kinds of work, as excavation, shaping road bed, unloading stone, etc. It will be noticed that the hauling is by far the largest item of expense, being 34 per cent of the total labor cost. Including unloading, hauling, spreading and rolling, it will be found that the average cost of placing a cubic yard of crushed stone on the road is very close to 60.5 cents. From these figures it will be possible to estimate the average cost of a given road as soon as the quantity of material to be used is determined.

TABLE 8.

*Average Labor Cost of Macadam Construction.*

(From data on twelve experimental roads. Total amount of crushed stone handled, 44,120 cubic yards.)

| Work. | Costs. | Per Cent. | Cost of handling 1 cubic yard stone. |
|---|---|---|---|
| Excavation | $ 5,079 43 | 12.4 | ..... |
| Shaping roadbed | 3,452 50 | 8.3 | ..... |
| Trimming shoulders | 2,226 19 | 5.3 | ..... |
| Superintendence, watchman and incidentals | 4,113 58 | 9.9 | ..... |
| Unloading stone from car | 4,205 25 | 10.1 | 9.6 |
| Hauling stone | 14,128 81 | 34.0 | 32.0 |
| Spreading stone | 3,537 15 | 8.5 | 8.0 |
| Rolling | 4,800 58 | 11.5 | 10.9 |
| Total | $41,543 44 | 100.0 | 60.5 |

A macadam road that is built twelve feet wide with two layers of stone spread five inches deep, measured loose, will require approximately 2,120 cubic yards, including the amount of material necessary for constructing the blind side drains and furnishing screenings for the binder. At 60.5 cents a cubic yard, it will therefore cost $,1282.60 to unload, haul and place this material. It should be stated that the average length of haul is to be not over one mile. If there is added to this sum the average cost per mile of excavation and shaping road bed, trimming shoulders and superintendence—$369, $251, $162 and $299, respectively—the estimated total labor cost per mile is $2,264.

A cubic yard of limestone is usually reckoned as 2,500 pounds. If the material can be obtained f. o. b. cars at destination for $1.00 a ton, the cost of one cubic yard will therefore be $1.25 and for the 2,120 cubic yards required the cost for the material will be $2,650 and the total cost for the mile of road twelve feet wide will be $4,914.

When the labor cost, as here computed, is compared with the labor cost of roads that have been built, it will be seen that the cost of the experimental roads so far constructed is greater per mile than $2,210.

A. East Nelson Township, Moultrie County. Earth road intersecting experimental macadam road. View taken March 10, 1908.

B. East Nelson Township, Moultrie County. Sullivan Road. Experimental, limestone macadam road built in 1907. View taken March 10, 1908. Some mud has been tracked on the road. Note that the traffic keeps in one track which combined with narrow tires makes ruts inevitable.

This is due to the fact that these roads are more than ten inches thick, and therefore more than 2,120 cubic yards of material were used in their construction. Although instructions had been given to make ten-inch roads, the fact that the material was furnished without cost developed a general inclination to be liberal in its use, and, unless a constant watch was kept, those in charge of the work would put on a greater thickness of stone. This thickness, however, is not needed for a serviceable road. When the material is paid for, and more economy exercised in its use, it will be found that the estimate of 2,120 cubic yards per mile, spread for a width of twelve feet, will give a road of ample thickness.

The estimate here given is on the basis that the haul averages about one mile. It is evident that as construction continues and the haul becomes longer the cost will be increased; so that if roads twelve feet wide are to be constructed for a stretch of four or five miles, the average labor cost would not be under $3,300; and if we estimate the cost of material at $1.00 a ton, the total cost of the mile would be about $5,900. In some localities material can be obtained for less than $1.00, but in many places it would cost more. The cost would, therefore, vary proportionately.

A lower estimate on the average cost would be arrived at by reducing the width of the road, which, on the whole, it is believed would be advisable in many instances. The objection to the narrow road has always been that there is not room enough for traffic to spread out, so that it necessarily would be confined to one track and, therefore, that portion of the road would receive an undue amount of wear and consequently would be more expensive to maintain. It has been a general recommendation to build no roads narrower than twelve feet. As a matter of fact, on all roads so far observed in Illinois, carrying only the ordinary country road traffic, there is no tendency for this traffic to spread over the road, whether it is twelve feet wide or wider. The vehicles invariably keep to the center and use at the most but eight or nine feet of width. Therefore, if a twelve foot road is to receive the same treatment as it would if it were but a ten foot road, there does not seem to be any reason to pay the extra first cost of making the additional two feet in width.

In many cases, however, where an experimental road has been undertaken the general impression is that a twelve foot road will be too narrow and the people usually desire a wider road. In nearly every instance, after they have used the twelve foot road they have seen that it is not only wide enough, but that there is a strip of a foot or two on each side which has scarcely been used at all, and that the edge of the road is not cut up by traffic turning out on it so that when plans for extending the work have been considered, a ten foot road has been desired.

The question of actual cost is discussed to show, by figures obtained from actual experience, the cost of this character of work.

Some recent discussions of macadam road construction, which have obtained wide circulation, have, in the minds of many, given the impression that the average cost per mile would not be over $2,000 or $3,000. It is perhaps a fact that in a few instances and under special conditions roads have been constructed as cheaply as described; but under average conditions, particularly in localities more or less remote from a supply of material, it is safe to say that roads cannot be built at any such low figure, and that any plans for extensive macadam road building based on an estimate of $2,000 or $3,000 a mile must bring in the end only disappointment to all interested.

Experimental, Reinforced Concrete Bridge. Clear span 40 feet, width of roadway 18 feet. Built by the Illinois Highway Commission by the aid of convict labor at the Southern Illinois Penitentiary, Menard, Illinois. It is proposed to load this bridge to destruction.

## Reinforced Concrete Bridge Test.

What is perhaps the largest reinforced concrete test in this country is at present under way. This test has been made possible through the coöperation of the authorities at the Southern Illinois Penitentiary, at Menard, at which point the test bridge has been constructed. This bridge was built in the prison yard on an old quarry floor, the rock being one and one-half feet to two feet below the surface of the ground.

The clear span or opening is forty feet and the width of the roadway is eighteen feet. The bridge rests on concrete abutments eighteen inches thick, which are carried to the surface of the rock. A view of this bridge is shown on plate 11. It is of the usual type designed and recommended for all short spans up to fifty feet openings for streams where there is not much head room, as is often found in Illinois. It is what is known as the through girder type; that is, the floor is suspended by reinforcing rods to the girders which form the sides of the bridge, rather than placing the floor on top of the girders, as is frequently done. One of the advantages gained by suspending the floor to the girders is that the under surface of the bridge is perfectly flat, which offers the least obstruction possible to brush and other debris that may be carried by the stream. Another advantage is the fact that the forms of this bridge are more easily made than for most other designs and the lumber is cut up to a much less extent, so there is a greater amount of salvage in the forms.

One of the interesting and significant features about this test is the fact that convicts have been employed in making the bridge; which is, perhaps, the first instance where convict labor has been used for the purpose of scientific investigation. By this method, the State is enabled to carry on this test on a very large scale and at the same time at a very small cost, as the chief expense is for the labor, not only in making the bridge, but also that which will be required to load and unload the amount of material necessary in testing the structure. The cost of the material, which includes steel reinforcing rods, cement and sand, is borne by the State Highway Commission.

This bridge was completed January 1, 1908, and is designed to carry, in addition to a twelve inch layer of macadam covering the floor of the bridge, a live load of 125 pounds per square foot and a concentrated load of twenty-four tons, distributed over a surface 10 by 12 feet.

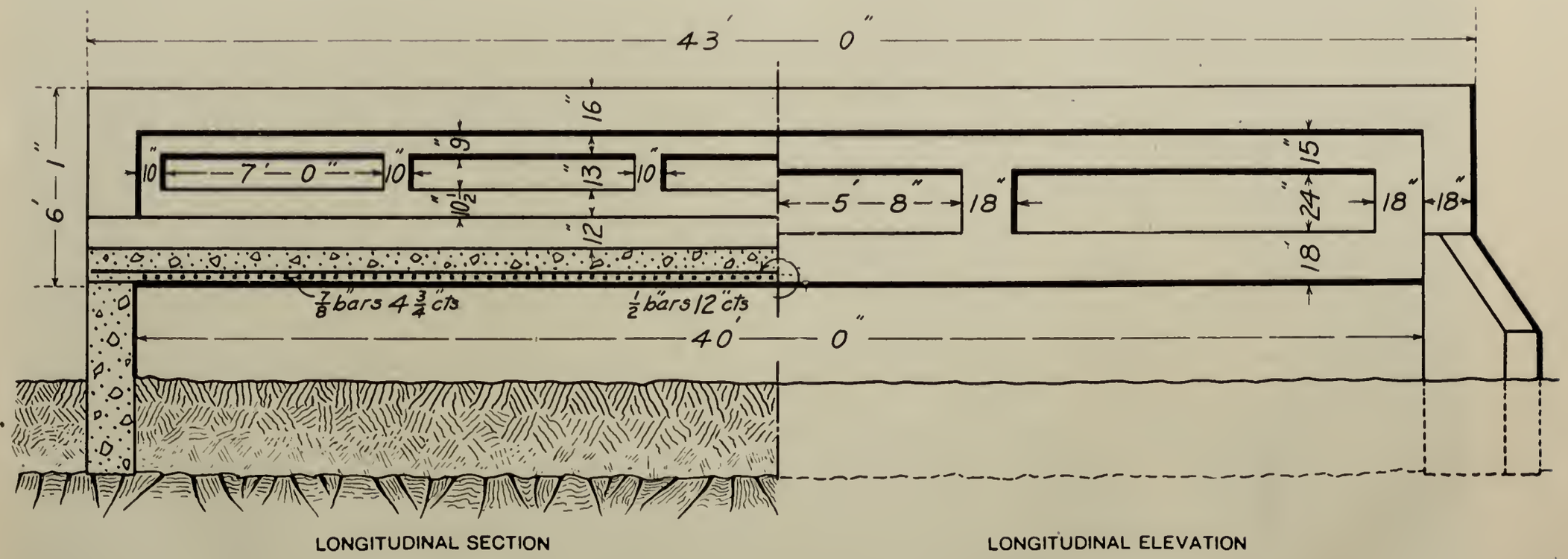



Fig. 13. Experimental Reinforced Concrete Bridge, Longitudinal Section and Elevation.

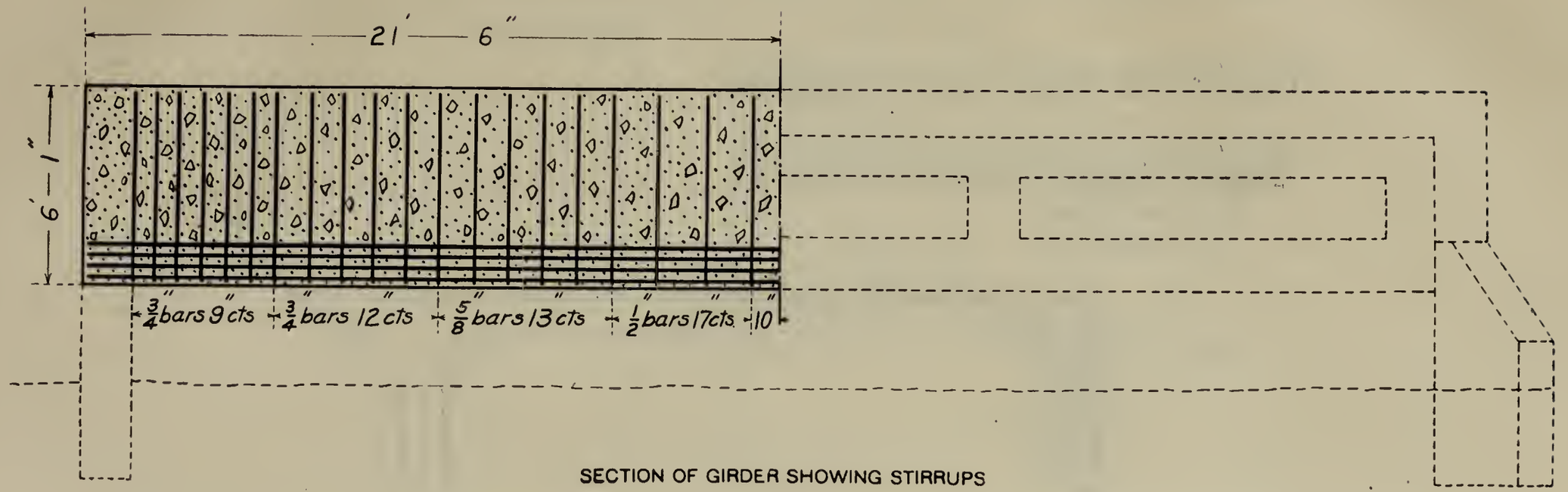



Fig. 14. Experimental Reinforced Concrete Bridge, Longitudinal Section of Girder Showing Stirrups.

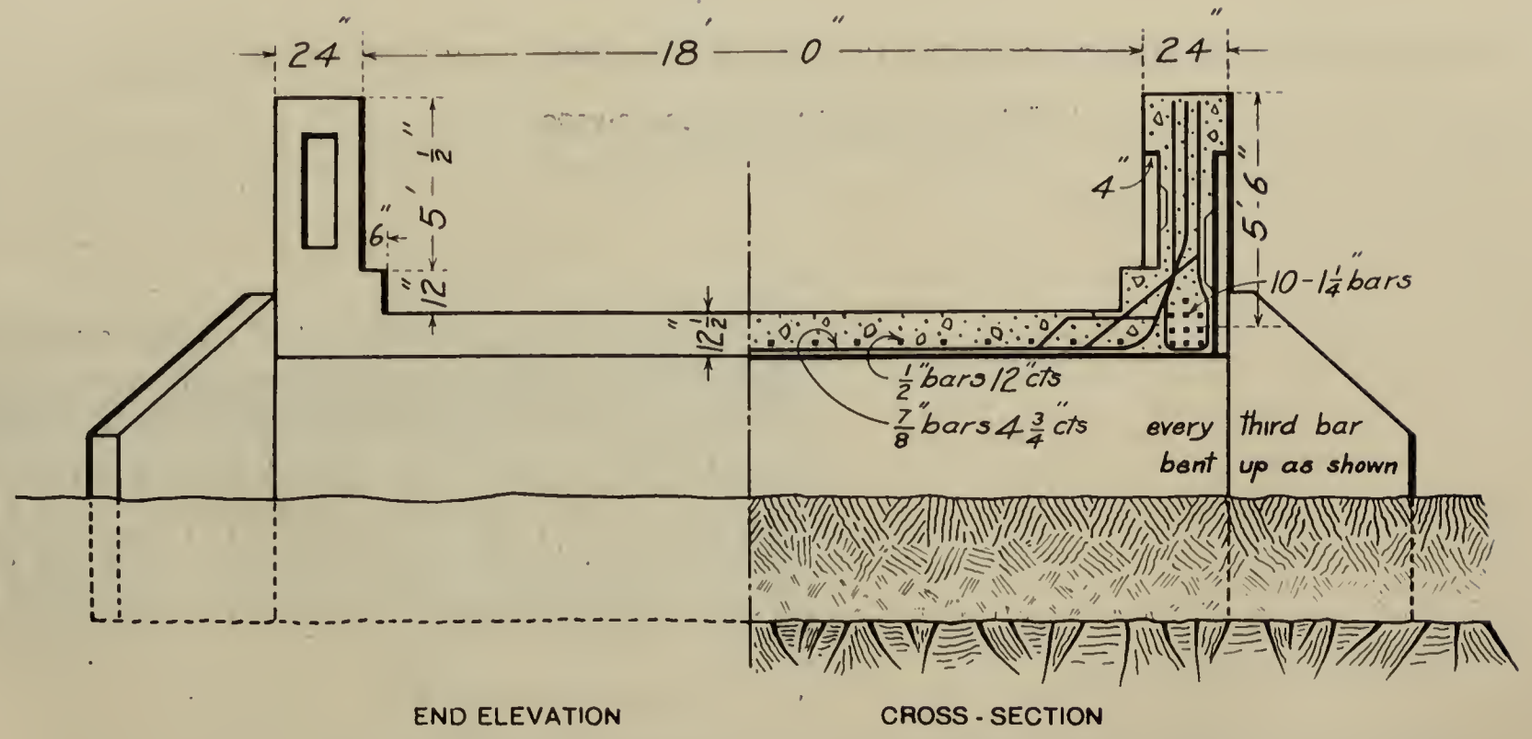



Fig. 15. Experimental reinforced concrete bridge, end elevation and cross section.

A. Type of wooden bridge largely used fifty years ago. This is one of the few bridges of this class which has not beeen replaced by steel or concrete.

B. Interior view of bridge shown above.

Figures 13, 14 and 15 show the details of construction. The concrete was mixed with proportions of one part cement, two and one-half parts sand and five parts broken stone. The broken stone varied in size from three-eighths inch to one and one-half inches. The amount of material used in the superstructure of the bridge—that is, in the floor and girders proper, excluding the abutments on which the floor rests—is 13,270 pounds reinforcing rods and 59.6 cubic yards of concrete.

The test that it is purposed to make of the bridge will include loading the bridge with a preliminary load equal to the full amount that the bridge was designed to carry. This load will be allowed to remain on the bridge for a number of days and then removed. The deflections in the floor and the girders will be noted. Careful measurements will also be taken between the tops of the girders, which it is anticipated will draw together.

Test samples of the concrete have been prepared, as well as test pieces of the various sizes of rods used, which will be tested so that all physical properties of the different materials of the bridge will be known.

The object in making the test is to see by practical applications of loads, far beyond what would come upon the bridge in ordinary use, the behavior of the bridge and to gain a knowledge of the strength of the structure as a whole, which can be had in no other way than by actual test.

It should be stated that this bridge was designed according to the formulæ for reinforced concrete by Professor A. N. Talbot of the University of Illinois. There is 1½% of reinforcement in the floor, and the girders, which were computed as a "T" beam, have a reinforcement amounting to 1% of the enclosed rectangle. The shearing stresses were computed and the resulting diagonal tension in the concrete provided for by vertical stirrups, which surround the reinforcement in the girders, but were not rigidly attached to it.

Aside from the scientific value of this test, it will also serve to demonstrate to the public generally the reliability of this form of construction and to create a demand for this class of bridge.

When the final results are known, a complete description of the bridge and the tests will be published so that the information will be available to engineers and builders throughout the State.

# Bridge Work.*

## Bridge Lettings.

Since the publication of the 1906 report, much additional information has been obtained concerning bridges, particularly as to the methods of letting and building them.

The customary method of procedure at the ordinary bridge letting has a marked tendency to lower the standard of highway bridges. When it is found necessary to build a bridge it is the custom of the commissioners to request each of the competing bridge companies to furnish a plan for the bridge, the bid of each company being based on the plan so prepared.

In order to secure a well designed bridge under this plan of procedure it is necessary to make rigid specifications as to loading and details of design under which the bridge is to be planned. After the proposals are submitted it is also necessary to make a careful examination of the plans in order to determine whether or not the conditions imposed have been fulfilled.

To handle the work successfully in this way requires technical knowledge and training which cannot be expected of the local officials. The requirements as to loading and design are almost always totally inadequate to insure a well designed structure and the lowest bid is usually accepted without a critical examination of the design. These facts being known to the bidders, the natural outcome of this system, where there is actual competition at the letting, is a rivalry among the bidders to produce a design which may be built at the least possibile cost to the contractor.

The resulting bridge is a structure lacking in many of the essential features necessary for strength and durability. Plans submitted at lettings where such conditions obtain are occasionally forwarded to the Commission to pass upon. Invariably they are found defective and usually to such a degree as to merit unqualified condemnation.

Even the dimensions of some of the important members are sometimes omitted on such drawings. The details of design, such as the number and spacing of the rivets, the thickness and size of splice plates and pin plates, the method of making connections at the joints, etc., are rarely, if ever, shown. The capacity of a structure to carry safely the loads for which it is designed depends upon the strength of the details as well as upon the strength of the main members. The

*This chapter on bridge work was prepared by Mr. Clifford Older, assistant engineer in charge of this work.

A. Fox Township, Kendall County. Holenback bridge before reconstruction.

B. Holenback bridge reconstructed, showing the old abutments supporting the new reinforced concrete superstructure, designed by the Illinois Highway Commission.

whole bridge may thus be rendered unsafe by the faulty construction of a single detail, and yet the planning of the details is left to the contractor without restriction of any kind.

The contract entered into is also frequently vague and misleading. It is usually written on a blank furnished by the bidder and often contains clauses which operate to release the contractor from responsibility of any kind. Several contracts examined contained a clause to the effect that for any member or detail another of different size, shape or weight might be substituted at the option of the contractor. This, of course, would make it unnecessary for the contractor to follow the plan submitted except as to general outline. What is familiarly called "skinning the bridge" is the result. That is, the plans, to appear attractive to the commissioners, may call for a strong, heavy structure; but the contractor, taking advantage of the substitution clause in the contract, and the lack of training of the commissioners, actually builds a much lighter, weaker and consequently cheaper bridge.

It has sometimes been found that the local officials retained no copy of the plans or the contract, and consequently were entirely at the mercy of the contractor. Numerous other advantages have been taken of the commissioners at the letting and in the construction.

Better results would be obtained if a single contractor were asked to furnish the plans, say ten days in advance of the letting; these plans placed on file, and all bidders required to submit a price on these plans. The contractor supplying the plans would have no object in furnishing a light design; the tendency, in fact, would be the opposite. This method would not, however, eliminate the possibilities contained in a poor form of contract.

The only way to secure results in conformity with the best modern practice is to secure the skilled supervision of an engineer from the inception of the project. Satisfactory results may then be obtained by requesting competitive plans which are to conform to rigid specifications prepared by the engineer. The engineer also passes upon the plans submitted, to determine whether or not they conform to the requirements previously outlined. The contract is then awarded to the lowest bidder, whose plans are made in accordance with the specifications.

The State Highway Commission has adopted as preferable the method of preparing the plans and specifications and requiring all bids to be submitted on these plans. Proposals are required to be made on blank proposal sheets, which are bound in covers with the plans, specifications and contract, all of which are prepared by the Commission. A copy of the proposal and contract blanks, together with the specifications for various classes of work, will be sent on application.

## Assistance Offered by the State Highway Commission.

The State Highway Commission undertakes to furnish to the various local commissioners such skilled advice as may be necesssary in the erection of their bridges.

An outline of the usual plan of procedure is given below. It should be understood that the services of the State Highway Commission in this regard are available to incorporated villages and towns and county boards of supervisors, as well as to the commissioners of highways of the various townships.

Upon receipt of an inquiry from the local officials, blanks are sent to them on which to make formal application to the State Highway Commission for engineering services to be rendered in connection with the bridge or bridges they contemplate building. Upon receipt of these blanks, properly filled and signed, the State Highway Commission sets a date for one of its engineers to meet with the commissioners and view the site of the bridge. The visiting engineer confers with the commissioners and makes definite recommendations in regard to the length of span and character of the structure. Plans and specifications are then prepared in the office of the State Highway Commission and forwarded to the local commissioners for their approval and for them to set a date and place for the letting. The date should be set at least fourteen days in advance of the return of the specifications and the place should, preferably, be in some public building, located, if possible, in a town or village conveniently reached by railroad. Upon return of the plans and specifications, duplicate copies are sent to the commissioners and notices of the letting are sent by the State Highway Commission to all of the bridge companies known to be in a position to do bridge work in this State. These notices, in addition to the time and place of the letting, give an outline of the work to be done, and as complete data as possible in regard to governing conditions, so that bidders may in many cases mail their bids without the expense of sending a man to inspect the site and attend the letting. This plan, which saves expense to the bidders, obviously reduces the cost of the structure to the commissioners and secures actual competition at the letting as well.

Plans and specifications are forwarded to such companies as may make request for the same, who, in turn, forward them with their bid made out on the proposal sheet attached to the specifications, to the town clerk or other official designated, to be opened at the hour and place determined upon.

The State Highway Commission, when requested to do so, has a representative at the letting, prepared with an estimate of the cost, to render what assistance may be possible at that time. When possible, the Commission also furnishes an inspector during the construction to see that the work is carried out properly and upon completion, in accordance with the plans and specifications, a final inspection is made and a certificate of completion is forwarded to the commissioners. In this way the commissioners secure a well designed and properly constructed bridge. There is no charge made the local officials for the services, plans, etc., furnished by the State Highway Commission.

A. Posts of a leg bridge destroyed by rust in twelve years. The sheets of paper show where the webs are entirely eaten through.

B. Reinforced concrete bridge designed by the Illinois Highway Commission. Built to take the place of the leg bridge mentioned above.

## The Cause of Bridge Failures.

A number of bridge failures have been viewed in the past year and a half, the cause of which has been, almost invariably, due to the lack of secure foundations.

It is a very common practice in Illinois to place steel bridges on a substructure consisting of tubes or a series of vertical I beams, commonly called legs.

In the case of tube bridges, there is generally supposed to be a pile driven into the ground beneath the tube, the top of the pile extending up in the tube a short distance. The tube around and above the pile is supposed to be filled with concrete.

Plate 18, figure A, is a view showing the tubes supporting one end of a steel bridge. It will be seen that the tubes in this case do not extend to the water line, and that the wooden pile is exposed to the action of the elements. The failure of this bridge might be expected when the piles have become weakened by rotting sufficiently to break off or crush, which would very probably occur when a traction engine or other heavy load was on the bridge, thus endangering life and property. The commissioners of the township in which this bridge is located wisely decided to build concrete abutments under all of their bridges.

Plate 15, figure A, shows the wreck of a tube bridge destroyed during high water and figure B the structure designed by the Illinois Highway Commission which now occupies the site. During the same period of high water not less than four tube bridges were destroyed in the same and adjoining county. Numerous other partial and complete failures of tube bridges have been viewed.

Plate 18, figure B, shows the failure of a leg bridge. In this case the timber on which the lower end of the beams rest was undermined. The unequal pressure of the earth on opposite sides of the bridge often causes the beams to become displaced, though they may not become undermined. Another serious objection to such bridges is, that the plank used back of the beams to support the earth requires frequent renewal. This is particularly expensive on account of the necessity of removing a considerable quantity of earth in order to replace the plank. In a few years the cost of repairs on such a bridge equals the cost of building a permanent structure of reinforced concrete.

Plate 14, figure A, shows two of the beams or legs of such a bridge rusted completely through after being in service but twelve years. This bridge was located on an important highway. Its weakened condition was unknown to the commissioners of the township, and it stood an actual menace to life and property until torn down in 1907. It was replaced in the fall of 1907 by the permanent reinforced concrete structure, designed by the Illinois Highway Commission, shown on plate 14, figure B.

## Concrete Bridges.

For the past year and a half the Commission has been designing reinforced concrete bridges for spans of forty-two feet and under;

also the longer span steel bridges have been designed with reinforced concrete floors, whenever it has been possible to induce the local officials to adopt that form of construction.

Reinforced concrete is now recommended for all spans under fifty feet in length. It has been found that for spans under forty or fifty feet reinforced concrete bridges may be built at a very reasonable cost, and that for the longer spans a reinforced concrete floor does not add an excessive amount to the cost of the bridge. For instance, a thirty foot reinforced concrete bridge, contracted recently, cost $130 more than a steel bridge designed for the same loading, with a plank floor and concrete abutments.

For spans under eighteen feet in the clear a simple reinforced concrete slab is used for the floor, the principal reinforcement running from abutment to abutment. Reinforced concrete side rails are used for this class of bridge and are considered preferable to pipe or angle rails because of their strength and durability.

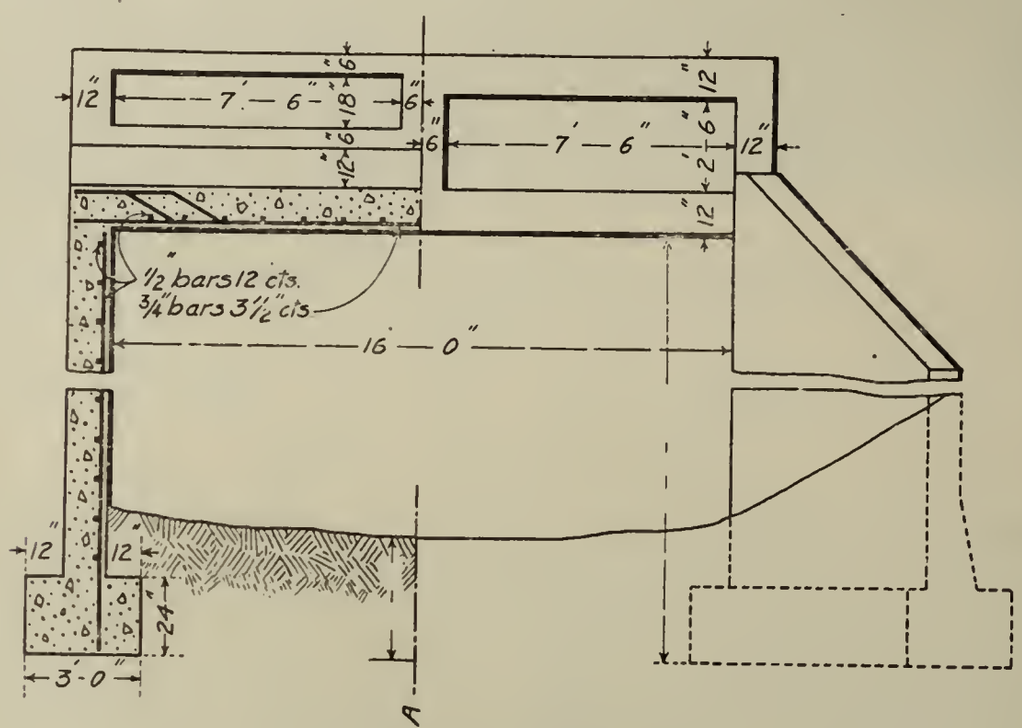
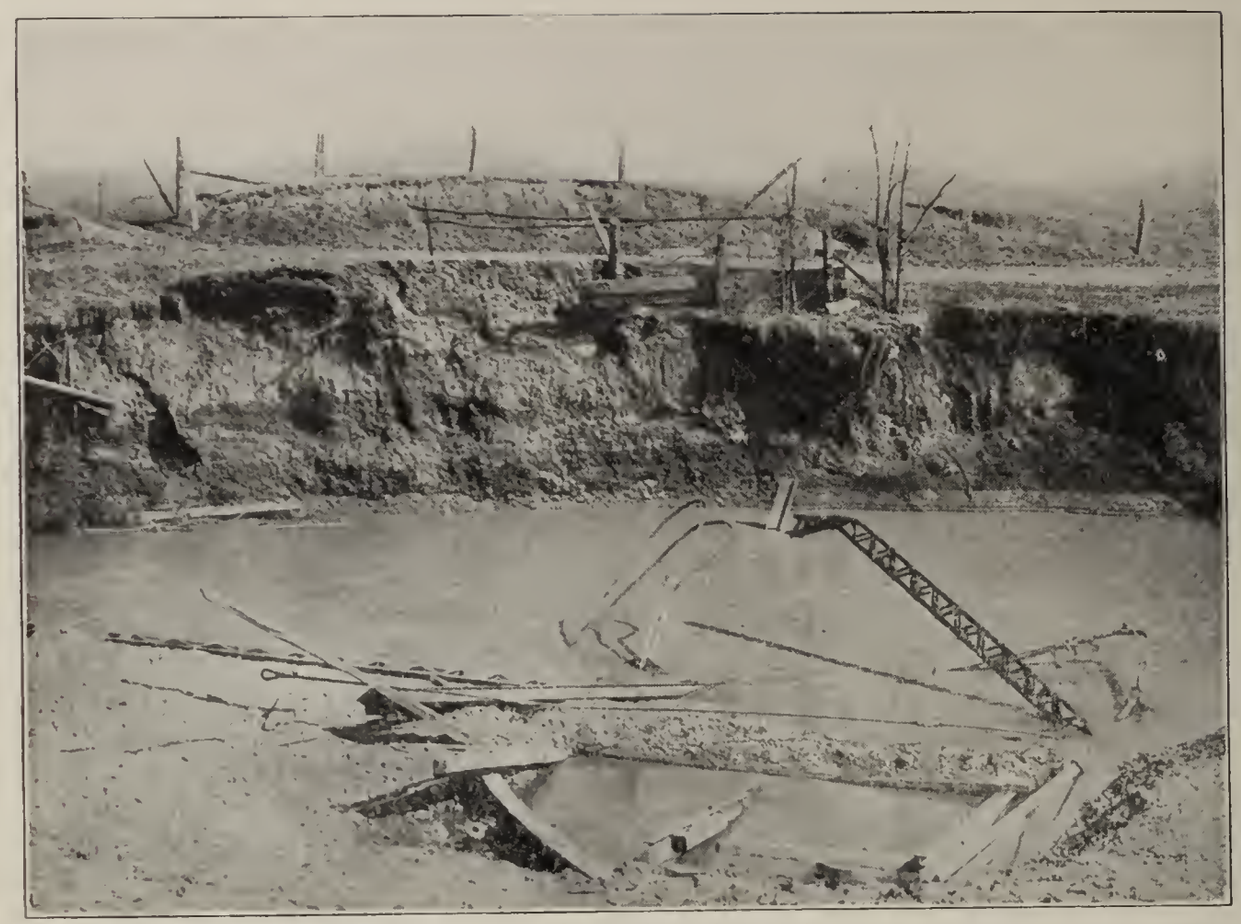



Fig. 16. Reinforced concrete bridge, 16 ft. span, longitudinal section and elevation.

Figures 16, 17 and 18 show the details of design of such a bridge. These bridges may be built more cheaply if several are built in the township in one year.

Where a number of slab bridges under twenty feet in span are built the same season, it may prove cheaper to use I beams to support the slab until the concrete has set than to use mud sills and timber posts. If this is done the abutments are carried up as usual to the height of the under side of the floor, pockets being left for the I beams; these pockets being about six inches wide and deep enough so that when opposing wedges are placed under the ends of the I beams the top flanges of the I beams will be two inches below the level of the bottom of the slab. Two inch planking is used to support the slab. When the concrete in the slab and rails has hardened sufficiently the



A. Wreck of a tube bridge destroyed by flood.

B. Spring Creek Township, Pike County. Bigbee Bridge. This bridge was designed by the Illinois Highway Commission to take the place of the bridge destroyed by flood, shown in view above. Note the concrete abutments. Approach span to be filled in.

wedges are removed and the floor forms drop down; the planks are drawn out at the side and likewise the I beams through the pockets in one of the abutments. The pockets are then filled with concrete. The I beams and plank may be used repeatedly.

A large number of slab bridges, under twenty feet in span, were designed and built in 1907. Blue Ridge township, in Piatt county, built about thirteen concrete bridges during the season. This township, in another year, will have concrete floors on all the longer span steel bridges and the shorter spans all replaced with reinforced concrete. Heretofore that township has been spending annually about one thousand dollars each year for bridge maintenance. After 1908 only an insignificant sum will be necessary for use in painting the steel bridges.

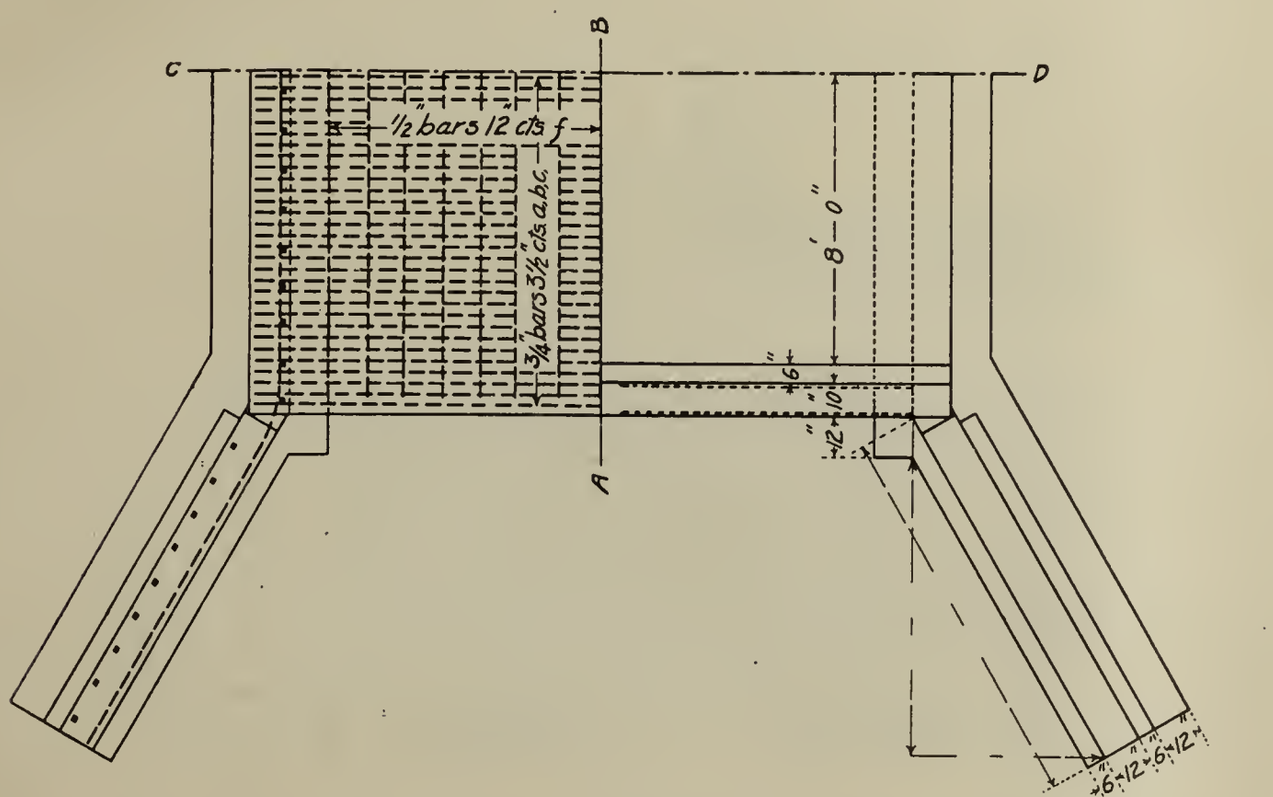



Fig. 17. **Reinforced concrete bridge, 16 ft. span, floor plan.**

For spans ranging in length from eighteen to forty-two feet the concrete rails have been designed as girders to carry the load to the abutments. The floor in this case is a reinforced concrete slab, the main reinforcement running from girder to girder. The floor is suspended to the girders by bending every third floor bar up into the girders. This type might well be classed as a reinforced concrete through girder bridge. This has proved to be a very economical design. The forms are very simple and much of the lumber remains uncut. The bending moment in the floor slab is independent of the length of the span, and consequently the amount of concrete and steel in the floor slab, for a given width of roadway, remains constant per foot of bridge. The rails or girders for bridges eighteen to thirty feet in span contain but little more concrete than would ordi-

narily be necessary for appearance and economical placing in the rail forms. For spans over thirty feet, and particularly for wide roadways, the girders become heavier, and it has been found necessary to design the girders with a heavy coping, giving the girders a T beam section. A number of girder bridges of this character have already been built and the plans drawn for several which will be built the coming season.

Figures 13, 14 and 15, showing the details of design of the experimental bridge built at the Southern Illinois Penitentiary at Menard, illustrate this type of construction.

Either the slab or girder type of bridge is better adapted to the comparatively level areas of this State than the concrete arch, as it is very desirable to secure the maximum amount of water way clearance with

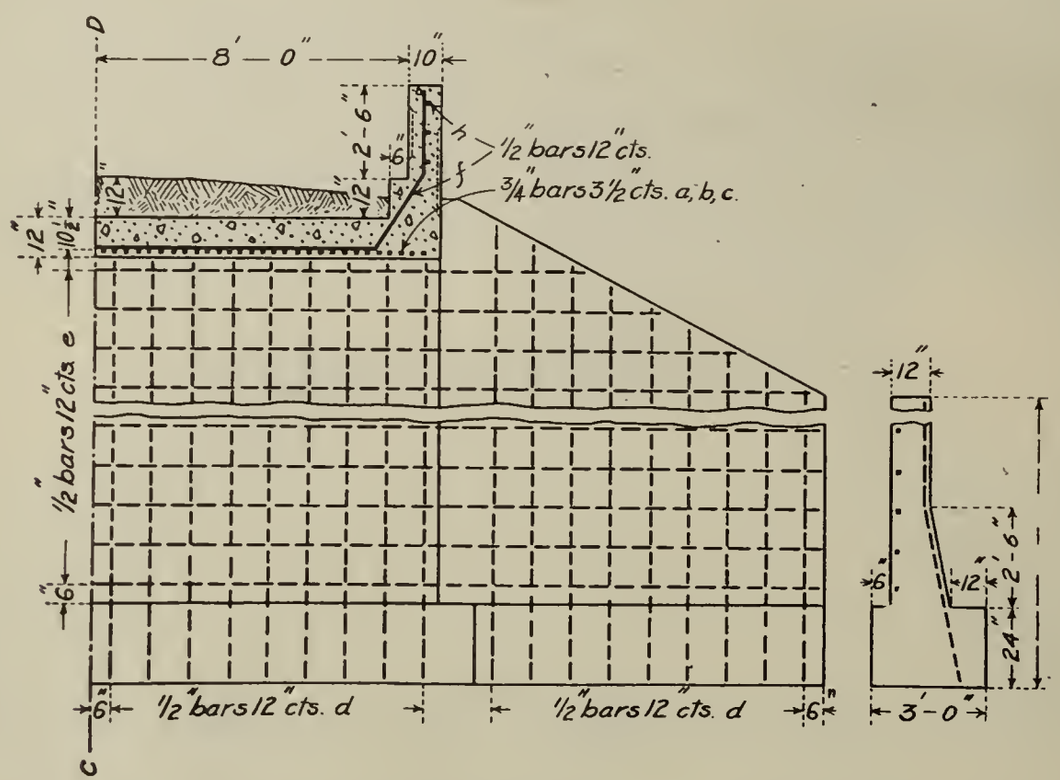



**Fig 18. Reinforced concrete bridge, 16 ft. span, cross section and elevation of abutment.**

a given length of span. The forms are also simpler and less concrete is necessary, and consequently they are more economical than arches.

In designing bridges of reinforced concrete, or steel bridges with concrete floors, provision is made for a cushion of gravel or macadam to reduce the impact and provide a wearing surface which may be renewed from time to time.

The Illinois Highway Commission has been advocating as widely as possible the use of reinforced concrete for bridges. The results of this may be seen in the fact that out of sixty-five bridges designed by the commission, and which are now completed or under contract, forty-four are reinforced concrete, the remainder being steel, some of which have concrete floors.

Delavan Township, Tazewell County. Haypenny bridge. This is a reinforced concrete bridge, having a clear span of 30 feet and a roadway of 16 feet. Built in 1906. Designed by the Illinois Highway Commission.

It is sometimes very difficult to induce the local officials to adopt a form of construction so radically different from that with which they are familiar, but usually it is only necessary to build one concrete bridge in a township to create a demand for this class of structure.

## Importance of Building Permanent Bridges.

A large proportion of existing bridges, as well as many of those now being built, are only temporary structures, and that because of the fact that our present expenditure for bridges is largely one of maintenance.

The majority of our bridges have span lengths of less than fifty feet and the largest portion of the bridge tax is spent in renewing these short spans. The cost of building permanent structures for such spans is reasonable.

It is evident that the annual expenditure for bridges might eventually be very materially reduced by adopting the policy of renewing these bridges with structures as nearly permanent as may be possible under the circumstances. The money thus saved from the bridge fund would make a welcome addition to the funds available for road purposes.

Practically permanent results may be obtained by using reinforced concrete bridges. This material is now very widely used for all forms of building construction and is generally recognized as one of the best and cheapest materials of construction for permanent works of all kinds.

## Painting Steel Bridges.

The importance of keeping steel bridges painted is not often given proper consideration by highway officials.

It is the exception rather than the rule to see steel highway bridges which have been sufficiently protected by paint to keep the steel from rusting. The steel bridges throughout the State show all degrees of rust, from mere first signs to almost complete destruction.

Elsewhere in this report will be found an illustration showing part of the steel of a small bridge rusted completely through in twelve years. The only way to account for the fact that this bridge did not fail before it was taken out is that it stood up from force of habit.

On many of the bridges which have been examined it was found that in places the effective thickness of the metal was reduced between 25 and 50 per cent by rust.

It goes without saying that steel bridges should be protected from rust as thoroughly as possible. How often should steel bridges be painted, is a question often asked. The only answer to give to this question is that they should be painted as often as the steel shows signs of rust.

It does not pay to use cheap, inferior paint, and it does not pay to apply the paint on a surface which has not been thoroughly cleaned of all scale, rust, old paint, grease and dirt. Probably the best paint for use on steel highway bridges consists of oxide of iron pigment

ground in linseed oil and mixed with pure raw linseed oil. If black is preferred, graphite prepared in the same way may also be used with good results.

The pigment used should be one subject to as little change as possible when exposed to the weather, and the vehicle should be pure, raw, linseed oil, as no equally good substitute has yet been found.

To sum up the requirements of painting: The paint should be applied on a clean surface; the paint should be composed of durable materials; and the bridges should be painted as often as may be necessary to protect them from rust.

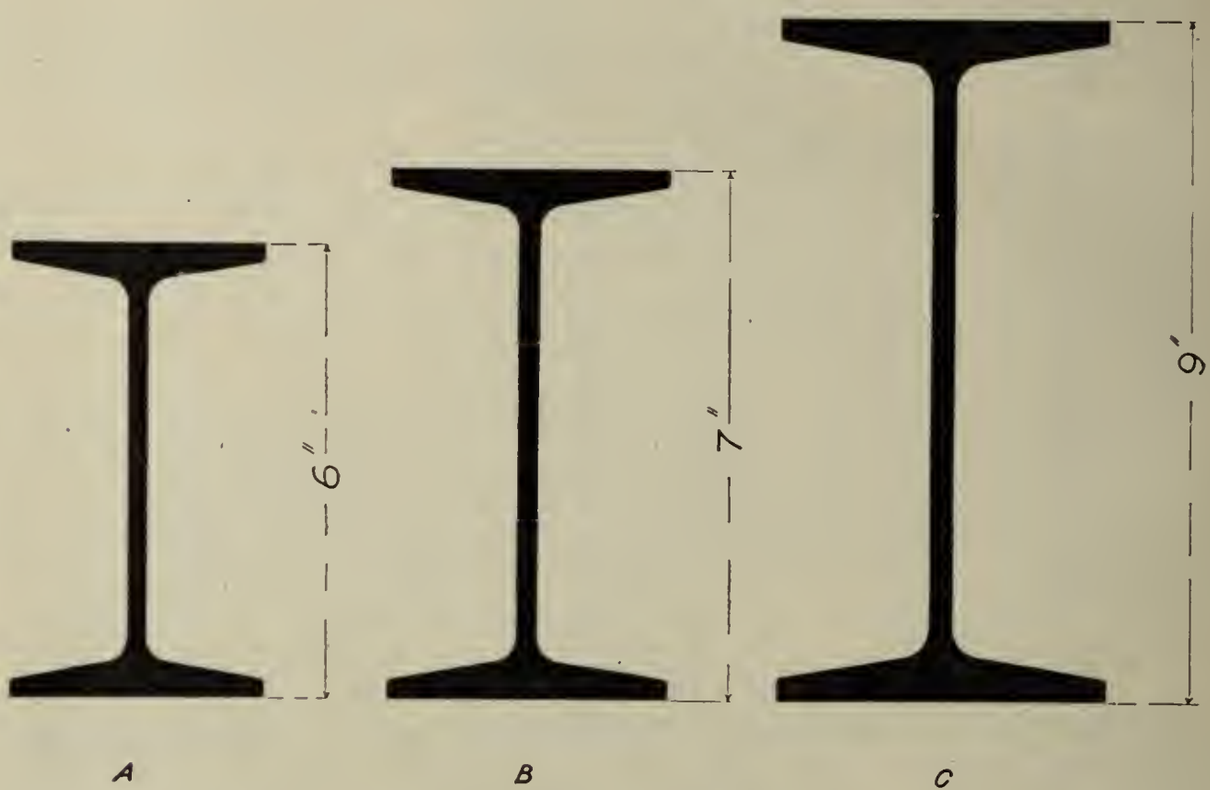



Fig. 19. Illustrating the different weights of floor joists required for same panel length under different loadings. "A" size required for uniform loading of 100 pounds per square foot. "B" size required for 15 ton traction engine, corresponding with second-class highway bridge designed by the Illinois Highway Commission. "C" size joists required for a 20-ton traction engine, as provided in first-class highway bridges designed by the Illinois Highway Commission. This illustrates how inadequate is the provision for 100 pounds per square foot for bridges that carry heavy traction engines.

## Bridge Specifications.

The past year's experience with the specifications as given in the report for 1906 showed that a number of minor changes and some additions should be made to make clearer certain requirements. This is especially true of the specifications for loading and stresses for steel bridges. Whereas, in the former specifications, only reference was made to Cooper's specifications, it has been thought better to give in detail the exact loadings and allowable stresses.

A. Fort Russel Township, Madison County. Heepke bridge before reconstruction.

B. Heepke bridge as reconstructed of reinforced concrete in 1907. The clear span of this bridge is 42 feet and the road way 16 feet. Designed by the Illinois Highway Commission.

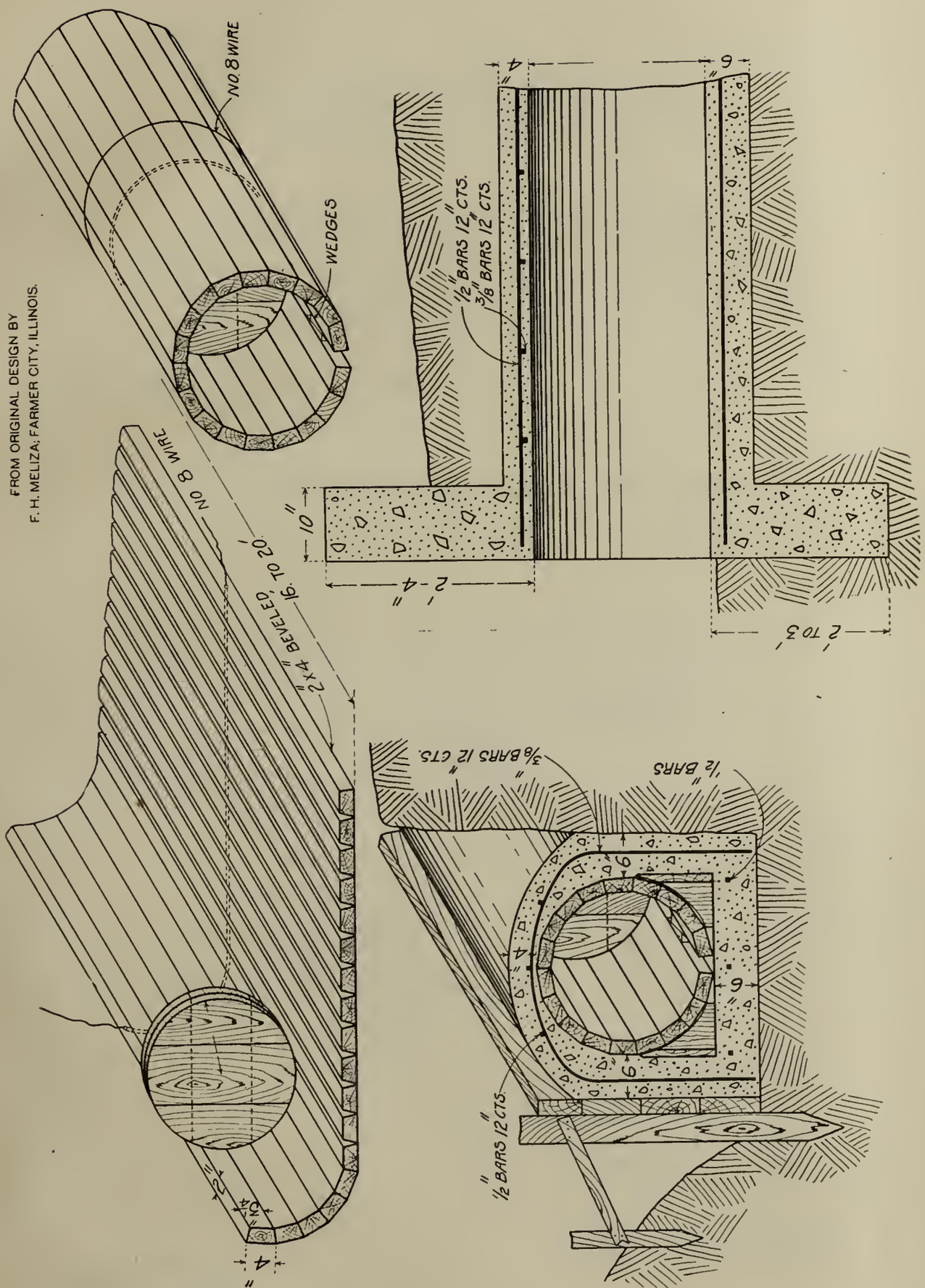
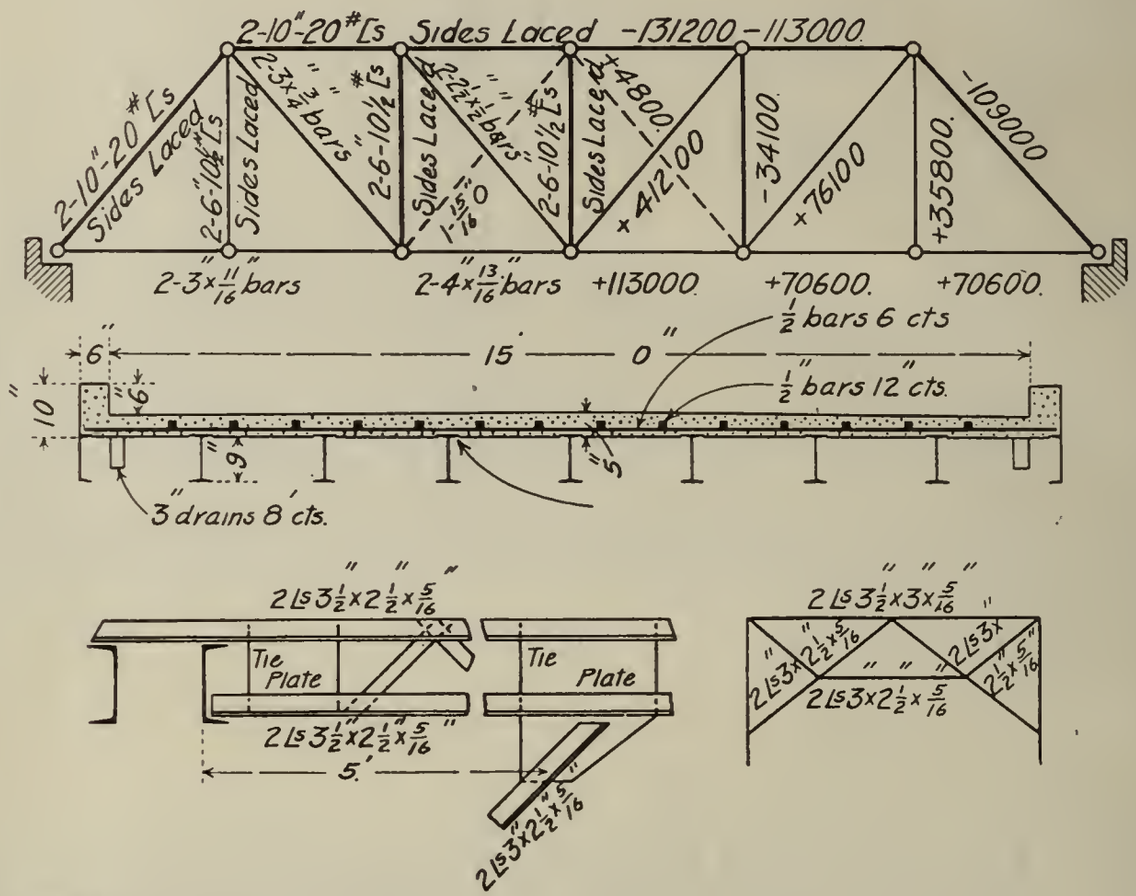



FIG. 20. Collapsible culvert form; a simple device for making forms for various size culverts from 18 inches to 3 and 4 feet in diameter. Forms for end walls are not shown in the figure. According to the size of the culvert, the number of staves to be used are placed side by side with a wire drawn through. They are then rolled around a circular head which has been cut to the required size of the culvert and wire bands tied tightly around the barrel on the outside. Wedges are then driven to hold the staves firmly. After the culvert has been built, the wedges are then removed and the head knocked in; the staves will then collapse and are easily removed. Staves are made of 2x4 pieces of wood with their edges bevelled and 2 or 3 sections used according to the length necessary to make the culvert. It is not necessary to cut the barrel to the exact length of the culvert as it is evident it may project beyond. This form may be used over and over again and works most satisfactorily.

ILLINOIS HIGHWAY CMOMISSION

**STEEL BRIDGE WITH CONCRETE FLOOR**

100 FT. SPAN, 16 FT. ROADWAY, 20 FT. HIGH




**NOTE**

FLOOR BEAMS
20 in. 65 lb. Is.

JOISTS
7 lines 9 in. 21 lb. Is.
2 lines 9 in. 15 lb. Cs.

TOP LATERALS
13-16 in. round.

LOADING
Dead, weight of bridge complete.
Live, 20 T. on 2 axles 10 ft. apart,
13 T. on rear, 7 T. on forward axle.
100 lbs. per sq. ft. on floor area,
except on panel occupied
by the concentrated load.

SPAN 100 ft. c. to c. of end pins.
HEIGHT 20 ft. c. to c. of pins.

PLAN
OF
SUPERSTRUCTURE
FOR
**HOPPS BRIDGE**
BETWEEN
**CLARION & LA MOILLE TOWNSHIPS**
**BUREAU COUNTY**
ILLINOIS

APPROVED - Feb. 8, 1908 A. N. Johnson STATE ENGINEER.

| | | |
|---|---|---|
| COMPUTED BY | - | C.E. Hoff |
| CHECKED BY | - | W.S. Gearhart |
| DRAWN BY | - | H.E. Bilger |
| DRAWING CHECKED BY | - | C. Older |

ILLINOIS HIGHWAY COMMISSION
PLAN No.
6.4-1
FEB. 7,
1908.
SPRINGFIELD, ILL.

FIG. 21. Facsimile of drawing to accompany specifications for a 100 ft. steel bridge, with a concrete floor.

A. Tube bridge showing wooden pile exposed above the surface of the water. An unstable and treacherous foundation.

B. Leg bridge with plank backing undermined. A very unsatisfactory Type of bridge and expensive to maintain.

Two classes of steel bridges are provided: One which is designed to carry a twenty-ton traction engine, called class A; and the second, or class B bridge, to carry a fifteen ton engine.

The class A bridge should be used on all main traveled roads, particularly in those sections of the country where the larger traction engines are being used. For bridges on more remote or less traveled roads, and in sections where there is not the need or demand for the larger traction engines, class B bridges can be recommended. It should be borne in mind that the class B bridge, when designed according to the State Highway Commission's specifications, is a much stronger and in every way more rigid structure than the majority of highway bridges which have been erected in the past.

There is a general tendency among township commissioners to select the structure which has the least first cost, provided it is a structure which apparently does the work for the time being. But, because of its permanence, wherever a bridge is to be built on a main traveled road, particularly a bridge that is located in the vicinity of a large town, the heavier type of bridge should in all cases be erected.

It is also recommended that all steel bridges should be sufficiently heavy in design to carry a concrete floor. For spans up to eighty feet, the increased first cost for bridges with concrete floor is not more than three or four renewals of the plank floor. The longer the span, the greater the difference between the first cost of a bridge designed to carry only a plank floor and one to carry a concrete floor. There are a few instances where the concrete floor is not to be recommended.

## Table of Costs.

The following table shows a list of the bridge designs which have been prepared by the Illinois Highway Commission. The name of the bridge and its location and type and general dimensions are given, together with the quantities and price wherever contracts have been let. It will be noticed that a number of the bridges shown have not been let. This is the case where designs have been made, but have not been used by the local officials or contracts have not been let up to the time this table was compiled. The table is divided into two parts, that for steel bridges and that for concrete bridges.

Rockton Township, Winnebago County. Wheeler Avenue bridge. The span of this bridge is 140 feet center to center of end pins, roadway 18 feet. This bridge is designed to carry a 5--foot sidewalk on the outside of each truss. Built in 1907. Designed by the Illinois Highway Commission.

TABLE 8.

*Summary of Bridge Plans and Estimates made by the State Highway Commission—Steel Bridges.*

CORRECTED TO JAN. 1, 1908

| NAME. | LOCATION. | | Kind of Bridge. | SPAN. | HEIGHT OF ABUTMENT. | ROADWAY. | Floor. | CONTRACTOR. | | CONTRACT PRICE. | | Extra Foundation. | Number of cubic yards. | Cost of substructure. | Total Cost. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | County. | Town. | | Feet. | Feet. | Feet. | | Superstructure. | Substructure. | Superstructure. | Substructure. | | | | |
| Kordsimon | Adams | Ursa | Steel on reinforced concrete | 50 | 15 | 16 | Wood | | | | | | 69.6 | | |
| Schleferdecker | ..do. | Columbus | Steel on stone | 60 | 21 | 14 | ..do. | | | | | | 215.6 | | |
| Payson | ..do. | Payson | Steel on concrete | 100 | 23 | 16 | ..do. | | | | | | | | |
| Pape Mill | ..do. | Melrose | ..do. | 130 | 17 | 16 | ..do. | | | | | | 186.3 | | |
| Lindley | Crawford | Hutsonville | ..do. | 90 | 20 | 16 | Concrete | Thatcher A. Parker | Tingley Bros. | $1,926 95 | $6 95 | | 205.0 | $1,424 75 | $3,351 70 |
| Heller | DeWitt | Santa Anna | ..do. | 80 | 13 | 16 | | | | | | | | | |
| Wilmuth | Douglas | Tuscola | Steel on reinforced concrete | 50 | 13 | 16 | Wood | | | | | | 59.3 | | |
| Elrod | Fulton | Bernadotte | Steel | 170 | | 16 | ..do. | | | | | | | | |
| Bollen | Henry | Geneseo | Steel on concrete | 140 | | 16 | ..do. | Elkhart Bridge Co. | Joliet Bridge Co. | | 8 50 | | 210.0 | | |
| Stimpson | ..do. | ..do. | ..do. | 140 | | 16 | ..do. | ..do. | ..do. | | 8 50 | | | | |
| Jeffrey | ..do. | ..do. | ..do. | 156 | | 16 | ..do. | ..do. | Burnham & Ives | | 0 80 | $560 54 | 295.8 | 3,458 80 | |
| Wolf | ..do. | ..do. | ..do. | 140 | 23 | 16 | ..do. | ..do. | Joliet Bridge Co. | | 8 50 | 418 40 | 238.0 | 2,007 00 | |
| Atkinson | ..do. | Atkinson | ..do. | 140 | | 16 | ..do. | Clinton Bridge Co. | Clinton Bridge Co. | 2,600 00 | 8 50 | 195 40 | | | |
| Bessee | ..do. | ..do. | ..do. | 140 | | 16 | ..do. | ..do. | ..do. | 2,600 00 | 8 50 | | 181 8 | | |
| Smith | ..do. | Alba | Steel | 120 | | 16 | ..do. | ..do. | | 2,246 00 | | | 225 0 | | |
| Jake Wolf | Lee | Subletto | Steel on concrete | 60 | 14.5 | 14 | ..do. | Continental Bridge Co. | | 820 00 | | | 101.2 | | |
| Dowd | ..do. | Harmon | ..do. | 60 | 13 | 60 | Concrete | Billmire Bridge and Iron Co. | W. H. Shons | 1,162 00 | | | 98 0 | 783 00 | 1,945 00 |
| Kimball | ..do. | | | | | | | | | | | | | | |
| Hill | McLean | Arrowsmith | Steel on concrete | | 14 | 16 | | | | | | | 95.9 | | |
| Stipp | ..do. | ..do. | ..do. | | 14 | 16 | | | | | | | 95.9 | | |
| Brown | ..do. | ..do. | ..do. | 40 | 14 | 16 | | | | | | | 95.9 | | |
| Snoddy | ..do. | ..do. | ..do. | | 14 | 16 | | | | | | | 95.9 | | |
| Sangamon | ..do. | ..do. | ..do. | | 14 | 16 | | | | | | | 95.9 | | |
| Houghman | ..do | ..do | ..do. | | 14 | 16 | | | | | | | 95.9 | | |
| Deer Creek | Logan | E. Lincoln | ..do. | 50 | 14 | 16 | Wood | | | | | | 74.7 | | |
| Oakley | Macon | Oakley | ..do. | 160 | 19.5 | 16 | ..do. | | | | | | 82 0 | 1,425 00 | 2,160 30 |
| Van Hooser | Madison | Olive | Steel on reinforced concrete | 50 | 17 | 16 | ..do. | Missouri Bridge and Iron Co. | Missouri Bridge and Iron Co. | 735 30 | | | 66.7 | | |
| Wenzel | ..do. | Fosterburg | Steel on concrete | 35 | 13 | 16 | ..do. | | | | | | 64.1 | | 1,390 00 |
| Burhle | ..do. | Hamel | Reinforced concrete | 30 | 14 | 16 | Concrete | | | | | | 112 5 | 1,175 00 | 1,810 00 |
| Whyers | ..do. | Fosterburg | Steel on concrete | 40 | 17 | 14 | Wood | Stupp Bros. | Stupp Bros. | 635 00 | | | 73 5 | | |
| Thenis Ford | Marshall | Steben | Steel on stone | 40 | 11.75 | 16 | ..do. | | | | | | | | |
| Beatty | Pike | Atlas | Steel on reinforced concrete | 120 | 25 | 16 | ..do. | | | | | | 179.1 | 698 49 | 2,274 49 |
| Dutch Creek | ..do. | ..do. | ..do. | 100 | 20 | 16 | ..do. | Illinois Steel Bridge Co. | B. B. Horton | 1,570 00 | | | 65.0 | 841 15 | 1,858 15 |
| Bird Slough | ..do. | Levee | ..do. | 80 | 17 | 16 | ..do. | Illinois Bridge Co. | ..do. | 1,017 00 | | | 34.0 | 2,380 00 | 3,766 00 |
| Bigbee | ..do. | Spring Creek | Steel on concrete | 80 | 27 | 14 | ..do. | LaFayette Engineering Co. | Alonzo Stevens | 1,386 00 | 7 00 | | | | |
| Middle Fork | Saline | Raleigh | ..do. | 70 | 15 | 16 | ..do. | | | | | | 80.4 | | |
| Schuyler | Schuyler | Frederick | ..do. | 140 | 19 | 16 | Concrete | | | | | | | | |
| McCal Ford | ..do. | Bain Bridge | | 52 | | 14 | Wood | | | | | | 71.6 | | |
| Hodgson | Tazewell | Elm Grove | Steel on reinforced concrete | | 17 | 15 | | | | | | | 72.0 | | |
| Oakdale | Washington | Oakdale | ..do. | 50 | 12 | 14 | Wood | Missouri Bridge and Iron Co. | Commissioners | 760 00 | | | 225 9 | | |
| Spring Valley | Whiteside | Ustlok | | 80 | 22 | 16 | ..do. | | | | | | 68 2 | | |
| Shepherd Ditch | ..do. | Fenton | Steel on concrete | 20 | 12.5 | 16 | ..do. | | | | | | 52 2 | | |
| Rock River | ..do. | Prophetstown | ..do. | 2 60 | 17.5 | 18 | ..do. | | | | | | 65.3 | | |
| Old Rock River | ..do. | ..do. | Steel on stone | | 17.5 | 18 | Reinforced concrete | | | | | | 175.3 | | |
| Rock River | ..do. | ..do. | Steel on concrete | | 17.5 | 18 | | | | | | | 271.1 | | |
| Allen | ..do. | Lyndon | Steel on reinforced concrete | | 27 | 16 | | | | | | | 214.6 | 1,373 41 | 5,371 44 |
| Wheeler Ave. | Winnebago | Rockton | Steel on concrete | 140 | 17 | 18 | Wood | LaFayette Engineering Co. | Continental Bridge Co. | 3,998 00 | 0 40 | | 43 7 | 438 00 | 438 00 |
| Crow Creek | Woodford | Linn | ..do. | | 9 5 | 18 | | | Burnham & Ives | | | 19 90 | | | |

TABLE 9.

*Summary of Bridge Plans and Estimates made by the State Highway Commission—Concrete Bridges.*

CORRECTED TO JAN. 8, 1908.

| NAME. | LOCATION. | | Kind of Bridge. | SPAN | HIGHT OF ABUTMENT | ROADWAY. | Contractor | SUPERSTRUCTURE. | | SUBSTRUCTURE. | | TOTAL. | | Cost of extra foundation. | Total Cost. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | County. | Town. | | Feet. | Feet. | Feet. | | Concrete—cubic yards. | Steel—pounds. | Concrete—cubic yards. | Steel—pounds. | Concrete—cubic yards. | Steel—pounds. | | |
| Frank Shriver | Adams | Mendon | Reinforced concrete | 10 | 11 | 20 | | | | | | 60.0 | 3,260 | | |
| Phillips | ..do.. | Concord | ..do.. | | | | | 19.7 | 3,952 | 45.0 | 1,383 | 64.7 | 5,335 | | |
| Turners | ..do.. | ..do.. | ..do.. | | | | | 8.1 | 1,132 | 27.4 | 955 | 35.5 | 2,087 | | |
| Clinton Branch | ..do.. | ..do.. | ..do.. | | | | | 10.2 | 1,568 | 37.2 | 931 | 47.4 | 2,499 | | |
| Hildebrand | ..do.. | ..do.. | ..do.. | | | | | 18.4 | 2,521 | 39.9 | 1,104 | 58.3 | 3,625 | | |
| Meyers | Bond | Burgess | ..do.. | 18 | 12 | 16 | | 18.4 | 2,521 | 35.3 | 1,107 | 53.7 | 3,629 | | |
| Greenville | ..do.. | Central | ..do.. | 5 | 5.5 | 24 | | | | | | | | | |
| Hartley | ..do.. | Shoal Creek | ..do.. | 20 | 11 | 16 | | 19.7 | 3,952 | 40.6 | 1,210 | 60.3 | 5,162 | | |
| Tanksley | ..do.. | ..do.. | ..do.. | 18 | 10 | 16 | | 18.4 | 2,521 | 34.8 | 1,000 | 53.2 | 3,521 | | |
| Valentine | ..do.. | ..do.. | ..do.. | 12 | 6 | 16 | | 10.2 | 1,568 | 22.5 | 521 | 32.7 | 2,089 | | |
| Plant | ..do.. | ..do.. | ..do.. | 16 | 9 | 16 | | 16.0 | 2,256 | 32.2 | 837 | 48.2 | 3,093 | | |
| Boston | DeKalb | Paw Paw | ..do.. | 40 | 13 | 16 | | | | | | 116.5 | 12,893 | | |
| Johnson | ..do.. | ..do.. | ..do.. | 40 | 13 | 16 | | | | | | 116.5 | 12,893 | | |
| Imus | ..do.. | | ..do.. | 12 | 7 | 16 | | | | | | 40.8 | 2,250 | | |
| Thompson Hollow | DeWitt | Creek | ..do.. | 4 | 7 | 20 | | | | | | 43.8 | 764 | | |
| Sugar Hollow | ..do.. | ..do.. | ..do.. | 7 | 12 | 20 | | | | | | 53.3 | 1,529 | | |
| Craig | Henry | Wethersfield | ..do.. | 12 | 12 | 16 | | | | | | 40.8 | 2,250 | | |
| Lyman | ..do.. | ..do.. | ..do.. | 6-11¼ | 9 | 16 | | 8.1 | 1,132 | 39.4 | 1,432 | 47.5 | 2,564 | | |
| Burston | ..do.. | Western | ..do.. | 16 | 12 | 18 | Joliet Bridge & Iron Co | 23.5 | 3,142 | 75.2 | 2,385 | 98.7 | 5,527 | | $1,140 00 |
| County Farm | Iroquois | Belmont | ..do.. | 8 | 7 | 18 | Homer Rush | | | | | 38.0 | 816 | | 245 00 |
| Parro | ..do.. | ..do.. | ..do.. | 4 | 7.5 | 16 | ..do | | | | | 10.9 | 229 | | 120 00 |
| Carlson | ..do.. | Loda | ..do.. | 18 | 8.5 | 16 | | 18.4 | 2,574 | 33.8 | 850 | 52.2 | 3,424 | | |
| Bad Island | Kane | Kaneville | ..do.. | 16 | 12 | 16 | | | | | | 50.7 | 3,383 | | |
| Swaney | ..do.. | ..do.. | ..do.. | 18 | 12 | 16 | | | | | | 50.5 | 3,000 | | |
| Rickert | Kendall | Fox | ..do.. | 15 | 9.5 | 16 | Joliet Bridge & Iron Co | | | | | 50.0 | 3,005 | | 010 00 |
| Hollenbaek | ..do.. | ..do.. | ..do.. | 27.5 | 13 | 16 | ..do | 27.7 | 6,158 | | | 27.7 | 6,158 | | 160 00 |
| Shehan | Knox | Lynn | ..do.. | 15 | 8.5 | 18 | Bloomington Bridge Co | | | | | 42.1 | 3,435 | | 040 00 |
| Ott | LaSalle | Grand Rapids | ..do.. | 5 | 4 | 16 | | 3.7 | 477 | 7.8 | | 11.5 | 477 | | |
| Gle'in | ..do.. | ..do.. | ..do.. | 30 | 7 | 16 | | 34.5 | 7,449 | 38.0 | | 72.5 | 7,449 | | |
| Morris Road | ..do.. | | ..do.. | 24 | 7.5 | 18 | | 65.4 | 7,743 | 37.9 | 2,868 | 103.3 | 10,011 | | |
| Nelson | ..do.. | Mendota | ..do.. | 7 10 | | 18 | | 7.6 | 781 | | | 7.6 | 781 | | |
| Lamberton | ..do.. | ..do.. | ..do.. | 10 | 8 | 26 | | 11.0 | 1,776 | 20.0 | 712 | 37.0 | 2,488 | | |
| Albert | ..do.. | Vermilion | ..do.. | 8 | 12 | 18 | Commissioners | 6.7 | 766 | 46.2 | 1,050 | 52.9 | 2,410 | | |
| E. Lincoln Road | Logan | | ..do.. | 10 | | 20 | | | | | | 24.0 | | | |
| West Bailey | ..do.. | Prairie Creek | ..do.. | 6 | 4.5 | 20 | | | | | | | | | |
| East Bailey | ..do.. | ..do.. | ..do.. | 8 | 6 | 16 | | | | | | 19.7 | 733 | | |
| Gabbett | ..do.. | ..do.. | ..do.. | 6 | 5.5 | 16 | H P. Fisk | | | | | 16.2 | 594 | | |
| Public Well | McLean | Dry Grove | ..do.. | 10 | 7.5 | 16 | Commissioners | 8.1 | 1,132 | 22.5 | 801 | 30.6 | 1,933 | | |
| McLean | ..do.. | ..do.. | ..do.. | 5 | 5 | 20 | | | | | | 24.5 | 540 | | |
| Jefferson Creek | Macon | Oakley | ..do.. | 30 | 11 | 16 | | 34.5 | 7,449 | 54.4 | 1,827 | 88.9 | 9,276 | | |
| North Road | Macoupin | Hunkerhill | ..do.. | 30 | 13 | 16 | | 34.5 | 7,449 | 57.8 | 2,065 | 92.3 | 9,514 | | |
| Groenemeyer | Madison | Collinsville | ..do.. | 6 | 14 5 | 18 | | 5.4 | 626 | 14.8 | 1,626 | 50.2 | 2,252 | | |
| Hoepkee | ..do.. | Ft. Russell | ..do.. | 40 | 14 | 16 | J. R. Challacombe | | | | | 130.0 | 14,050 | $70 71 | 2,220 71 |
| Neunaber | ..do.. | ..do.. | ..do.. | 6 | 10 | 20 | | | | | | 42.1 | 1,037 | | |
| Kerr | ..do.. | ..do.. | ..do.. | 12 | | 16 | | 10.2 | 1,551 | | | 10.2 | 1,551 | | |
| Whyers | ..do.. | Posterburg | ..do.. | 40 | 15 | 16 | | 50.6 | 10,597 | 75.1 | 2,559 | 125.7 | 13,156 | | |
| Hulrie | ..do.. | Hamel | ..do.. | 30 | 12 | 16 | J. R. Challacombe | 34.5 | 7,449 | 58.6 | 2,006 | 93.1 | 9,455 | | 1,380 00 |
| Rock Branch | ..do.. | Moro | ..do.. | 30 | 11 | 16 | | 34.5 | 7,449 | 51.2 | 1,743 | 85.7 | 9,192 | | |
| Sherlf | ..do.. | Omphghent | ..do.. | 12 | 14 | 16 | Ernst Hruene | 10.2 | 1,479 | 55.3 | 1,741 | 65.5 | 3,220 | | 605 00 |
| Thenis Ford | Marshall | Steben | ..do.. | 40 | 10.5 | 16 | | 50.6 | 10,597 | 01.7 | | 112.3 | 10,597 | | |
| North Road Culvert | Montgomery | Hillsboro | ..do.. | 3 | 5 | 20 | C. D. Fry | 3.3 | 240 | 13 2 | | 16.5 | 240 | | $123 00 |
| Heil Farm | ..do.. | ..do.. | ..do.. | 6 | 6.5 | 20 | Commissioners | | | | | 24.8 | 708 | | |
| Toberman | ..do.. | ..do.. | ..do.. | 10 | 9.5 | 20 | ..do | 8.8 | 1,406 | 20.5 | 1,110 | 29.3 | 2,516 | | |
| Sawyer | ..do.. | ..do.. | ..do.. | 3 | 7 | 20 | ..do | | | | | 19.0 | 226 | | |
| Brown Culvert | ..do.. | ..do.. | ..do.. | 4 | 7.5 | 20 | ..do | | | | | 23.0 | 284 | | |
| North Miller | ..do.. | ..do.. | ..do.. | 16 | 8 | 16 | | 16.0 | 2,294 | 32.4 | 782 | 48.4 | 3,076 | | |
| South Miller | ..do.. | ..do.. | ..do.. | 6 | 7 | 16 | | 4.2 | 545 | 17.5 | | 21.7 | 545 | | |
| South McDavid | ..do.. | ..do.. | ..do.. | 12 | 8.5 | 16 | | 10.2 | 1,479 | 34.2 | 874 | 44.4 | 2,353 | | |
| North McDavid | ..do.. | ..do.. | ..do.. | 8 | 9.5 | 16 | | 6.3 | 710 | 30.1 | | 36.4 | 710 | | |
| Cemetery | Piatt | Blue Ridge | ..do.. | 12 | 8 | 20 | Commissioners | | | | | 45.0 | 2,500 | | |
| Trenkle | ..do.. | ..do.. | ..do.. | 2-36 | 13 | 16 | ..do | | | | | 160.0 | 24,262 | | |
| Harris | ..do.. | ..do.. | ..do.. | 18 | | 18 | ..do | | | | | | | | |
| Hoffman | ..do.. | ..do.. | ..do.. | 12 | 7 | 16 | ..do | | | | | 32.0 | 1,490 | | |
| McGrath No. 1 | ..do.. | ..do.. | ..do.. | 6 | | 20 | ..do | | | | | | | | |
| McGrath No. 2 | ..do.. | ..do.. | ..do.. | 6 | | 14 | ..do | | | | | | | | |
| Webb | ..do.. | ..do.. | ..do.. | 10 | | 18 | ..do | | | | | | | | |
| Smithton Arch | St. Clair | Smithton | Plain concrete | 10 | 11 | 20 | | | | | | 106.5 | | | |
| Stoolkey | ..do.. | ..do.. | Reinforced concrete | 12 | 9 | 16 | | 10.3 | 1,489 | 35.7 | 977 | 46.0 | 2,466 | | 410 03 |
| Grancolas | ..do.. | ..do.. | ..do.. | 20 | 12.5 | 14-11 | Commissioners | 22.7 | 3,503 | | | 22.7 | 3,503 | | 261.98 |
| Biebel | ..do.. | ..do.. | ..do.. | 10 | 9.5 | 16 | ..do | 8.1 | 1,132 | 27.0 | 1,016 | 35.1 | 2,148 | | |
| Richland | ..do.. | ..do.. | ..do.. | 30 | 10 | 16 | | 34.5 | 7,449 | 39.8 | 1,428 | 74.3 | 8,877 | | |
| Leuthmeier | ..do.. | ..do.. | ..do.. | 20 | 11 | 16 | | 19.7 | 3,952 | 44.4 | 1,321 | 64.1 | 5,273 | | |
| Reinhardt | ..do.. | Lenzburg | ..do.. | 24 | 8 | 16 | | 25.3 | 5,153 | 35.8 | 1,188 | 61.1 | 6,341 | | |
| Valerous | ..do.. | Smithton | | | | | | | | | | | | | 295 15 |
| South Sixth Street | Sangamon | Capital | Reinforced concrete | 4 | 7 | 30 | Commissioners | | | | | | | | |
| Pawnee | ..do.. | Woodside | ..do.. | 4 | 7 | 60 | | | | | | | | | 740 00 |
| Crooks | Tazewell | Cincinnati | ..do.. | 10 | 16 | 20 | Tremont Bridge & Concrete Co | | | | | | | | 995 00 |
| Haypenny | ..do.. | Delevan | ..do.. | 30 | 14 | 16 | Burnham & Ives | | | | | 90.6 | 8,630 | | 750 00 |
| Heiser | ..do.. | Elmgrove | ..do.. | 14 | 10 | 16 | Tremont Bridge & Concrete Co | 14.9 | 3,019 | 43.4 | 1,029 | 58.3 | 4,046 | | |
| Count Ditch | Whiteside | Fenton | ..do.. | 30 | 14 | 16 | | 34.5 | 7,449 | 65 0 | 2,320 | 99.5 | 9,769 | | |
| Keegan | ..do.. | ..do.. | ..do.. | 20 | 13 | 16 | | 19.7 | 3,952 | 57.5 | 1,686 | 77.2 | 5,638 | | |
| Stowell | ..do.. | Garden Plain | ..do.. | 18 | 10 | 16 | | | | | | 56.5 | 3,900 | | |
| Rusohke | ..do.. | Lyndon | ..do.. | 24 | 9 | 16 | | 26.8 | 4,769 | 52.3 | 1,834 | 79.1 | 6,603 | | |
| Aylsworth | ..do.. | Prophetstown | ..do.. | 40 | 18 | 16 | | | | | | 141.3 | 13,233 | | |
| Creamery | ..do.. | Ustick | ..do.. | 30 | 15 | 16 | Thomas Kelly | 34.5 | 7,449 | 71.8 | 2,558 | 106.3 | 10,007 | | 1,154 00 |
| James Mathew | ..do.. | ..do.. | ..do.. | 30 | 11 | 16 | | 34.5 | 7,449 | 44.4 | 2,093 | 78.9 | 9,542 | | |
| Kaffer | Will | Manhattan | ..do.. | 8 | 6.5 | 16 | | | | | | 19.7 | 723 | | |
| North Mud Creek | ..do.. | ..do.. | ..do.. | 40 | 11.5 | 18 | | | | | | 131.9 | 14,895 | | |
| Brewster | Winnebago | Owen | ..do.. | 10 | 8.5 | 16 | Budlong-Foster Co | 8.1 | 1,132 | 22.5 | 803 | 30.6 | 1,935 | | 390 00 |
| Meridian | ..do.. | ..do.. | ..do.. | 16 | 6.5 | 16 | ..do | 16 0 | 2,294 | 26.7 | 556 | 42.7 | 2,850 | | 409 00 |
| Latham Park | ..do.. | ..do.. | ..do.. | 42 | 11 | 18 | | 65 2 | 15,396 | 70.0 | 2,100 | 135.2 | 17,496 | | |
| Brown Creek | ..do.. | ..do.. | ..do.. | 2-32½ | 18 | 18 | | | | | | | | | 198 00 |
| Snag Creek | Woodford | Linn | ..do.. | 12 | | 15 | Burnham & Ives | 10.3 | 1,480 | | | 10.3 | 1,480 | | |
| Slough | ..do.. | ..do.. | ..do.. | 10 | 7 | 16 | | 10.2 | 1,392 | 22.7 | 709 | 32.9 | 2,101 | | |
| Van Seyoo | ..do.. | Palestine | ..do.. | 12 | 9 | 18 | | | | | | 38.3 | 3,081 | | |
| Oster | ..do.. | ..do.. | ..do.. | 8 | 5.5 | 18 | | | | | | 21.0 | 856 | | |

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